Draft literature review
Oct. 2013

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1.2 Research Questions

The research sought to address a number of questions broadly associated with the idea of accidental or incidental learning from video games.

Q1 To what extent do video games influence learning in the generations who have grown up with them?

Are there learning outcomes from commercial video games (knowledge, skills or attitudes)?

If so, is this learning something gamers are aware of, reflect on, or value? And by corollary, is learning through gaming something that commercial game developers are aware of, reflect on, or value?

And, what form does this learning take; does it extend beyond the direct game experience, i.e. transferable or transformative learning?

Also, are we aware that we are being or have been educated? If little or no knowledge has been transferred, have we developed 'soft skills' as a result of playing games? Does planning our strategies and discussing or documenting our experiences better equip us to deal with other aspects of academic or professional life?

Q2 Have video games influenced or inspired academic direction or vocational choices?

Can games act as the seed or 'kernel' for later learning?

How often are players inspired by game content to find out more, and from other sources?

Do normative aspects of game content influence cultural, social or political attitudes and beliefs?

What, if any, transferable skills and behaviours are developed through gaming?

Q3 Can commercial video games be used more widely to facilitate learning?

If video games have taught us anything, how have they done so?

How can we make best use of commercial video games?

Might such games be used in more extensively in higher education than is currently the case?

2. Literature Review

The learning potential of computer and video games has already received some considerable academic attention, as has the design and development of bespoke educational titles, which typically fall within the purview of 'serious games'. Researchers including Gee (2003) and Jenkins (2008) have been particularly vocal in suggesting the pedagogical value of video games. However, with some notable exceptions, such as the work of Kurt Squire with the *Civilization* games (2004), Derek Robertson (Robertson & Miller, 2009) and Simon Egenfeldt-Nielsen (2005), the potential to learn from commercially-released games — those designed to entertain, rather than educate — has not been explored fully. In addition, much of the existing research has pertained to school-age children using video games in, or alongside, their regular classes. Perhaps this is to be expected: it is widely accepted that humans and other animals learn through play, and structured play forms an important part of primary-level education (Bruce, 1987; Moyles, 1989). If video games, which many incorrectly assume are played for the most part by children, are simply toys with educational potential then it follows that much of the initial work in this area has concerned minors.

In Video Games and Learning (2011, p.5), Squire suggests that we can learn 'academic' content through games, including the in-game terminology, a range of strategies, and "the emergent properties of the game as a system". That video games can help develop systemic understanding – analysing the game world, as opposed to simply learning facts – is an idea echoed by James Paul Gee (2005, p.82), who states that what gamers learn is "empathy for a complex system" (Gee's work is discussed in more detail below). Both Squire and Gee note that the best-designed games typically comprise a series of coinciding or intersecting goals, with short-, medium- and long-term conclusions. They suggest that this arrangement of goals, which permits the student to progress on a number of fronts simultaneously — even when one goal is seemingly out of reach — has significant advantages for student engagement because those struggling with one task can choose to make headway on another, rather than disengaging altogether. Such overlapping goals are familiar to anyone who has played Bioware's *Star Wars: Knights of the Old Republic*, Blizzard's *World of Warcraft*, or the later *Grand Theft Auto* games from Rockstar. However, they are perhaps more difficult to implement in a structured, often didactic, educational environment such as a school or university, where curricula may not offer the flexibility to allow different students to be working on many different problems at the same time. At most stages in our education we do take a mixture of subjects, but there is little latitude for individual students within a class to simultaneously study completely unrelated topics.

This chapter aims to provide an overview of current research in the field of video games and learning, drawing on established key texts and more recent papers. It will begin with an overview of some of the most relevant educational and learning theory. Moving on to games, the chapter will look at games developed specifically for educational purposes, then go on to examine some of the characteristics of games that make them suitable for education, and discussing the learning potential in commercial video games.

Taxonomies of learning

An area of learning theory which might be considered to sit apart from much of the rest is that concerned with how learning is measured or quantified and, ultimately, assessed. Course learning objectives (or aims) and intended learning outcomes are terms familiar to most 21st century educators and are most often closely coupled to the material being taught. More generally applicable taxonomies of learning may be used to describe pedagogical attainment in a wide variety of educational settings. Bloom's Taxonomy (Bloom, 1956) – perhaps the most widely cited such classification – comprises three domains: cognitive (related to knowledge), affective (attitudes and values) and psychomotor (skills) originally conceived as a means of making assessment more systematic (Draper, 2005). The first of these domains – cognitive – is by far the most widely cited in the educational literature, while the psychomotor domain was never actually completed by Bloom and instead has been fleshed out by others [. Bloom's affective domain model (Bloom et al, 1964), while less frequently cited and perhaps less readily understood, is also relevant to learning from video games, and is discussed briefly below.

While Bloom's model of the cognitive domain is concerned primarily with knowledge, the ability to recall or recite knowledge is merely the first level in the hierarchy. From this starting point, the learner may move on to comprehend (make inferences from, or reconstruct) acquired knowledge and ultimately be able to apply it, perhaps in scenarios other than those in which the material was originally presented. Beyond this point, they begin to analyse and organise information, synthesise and reorganise it and, ultimately, evaluate and critique what they know.

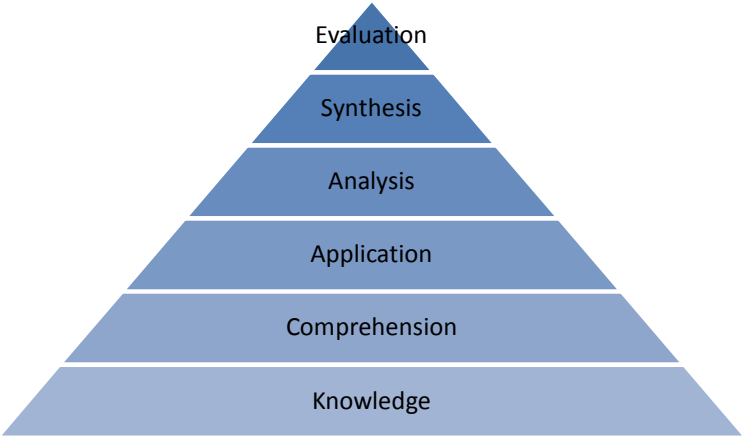


Figure 1: Bloom's Taxonomy – Cognitive Domain (adapted from Bloom, 1956)

Bloom's mapping of the affective domain (Bloom et al, 1964) deals with what the authors refer to as "values", or emotional responses and attitudes. It starts at the lowest level, 'Receiving', wherein the learner is no more than aware of the issues being put forward or phenomena experienced. As the learner moves up the hierarchy through 'Responding' and 'Valuing', they become better able to place a value on the issues at hand and begin to categorise and group these values into a system. In gaming terms, the affective model seems to correspond best with social aspects of multiplayer games, wherein players become more adept at playing in teams and prioritising interactions with other players as they ascend the hierarchy. Aside from their engagement with other players, the affective domain might also be used to describe how players deal with the issues presented by more complex games' content.

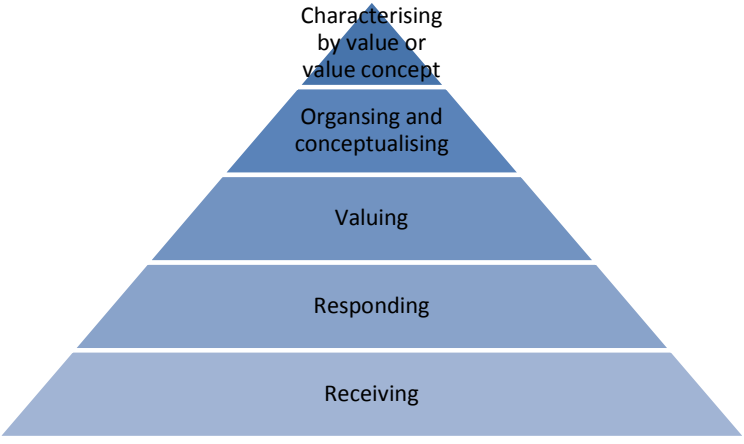


Figure 2: Bloom's Taxonomy – Affective Domain (adapted from Krathwohl et al, 1965)

Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Raths and Wittrock (2001) updated Bloom's model of the cognitive domain to place greater emphasis on the creation of new knowledge (see figure below). In addition to the six levels of cognitive process, Krathwohl et al introduced an additional dimension in the form of four types of cognitive process (factual, conceptual, procedural and metacognitive). While it is not always presented as a hierarchy, the taxonomy presented by Krathwohl et al can clearly be mapped to the Bloom hierarchy on which it is based, with 'Creating' replacing 'Evaluation' at its pinnacle. Aside from this change in emphasis, and the addition of a 'types' dimension, the most significant difference between the two taxonomies is perhaps the shift to using verbs to describe each of the levels. Bloom's 'Application' has, for example, become 'Applying'. This emphasis on action or on doing seems to suggest that the later taxonomy aligns more closely with constructivist theories of learning and is in turn, perhaps, more readily applied to learning from video games.

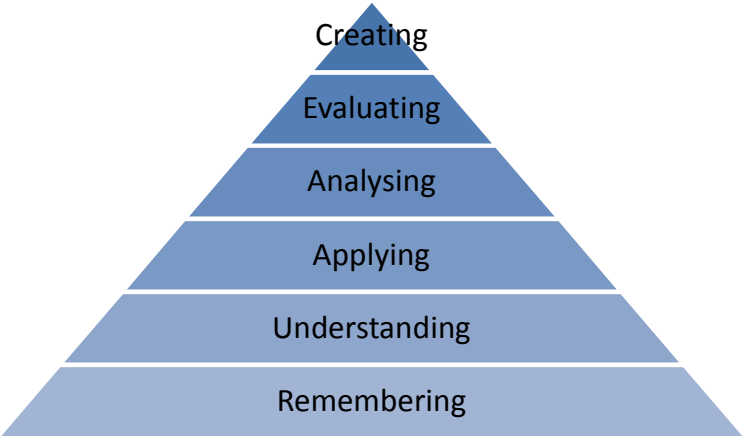


Figure 3: Anderson and Krathwohl's revision of Bloom's Taxonomy (adapted from Krathwohl et al, 2001)

One might express Anderson & Krathwohl's taxonomy in terms of engagement with video games as follows, beginning with the lowest level:

Level	Application
Remembering	Recall of control scheme and basic premise, setting and genre.
Understanding	Comprehension of game mechanics and required player interactions.
Applying	Ability to play the game and to progress.
Analysing	Recognition of patterns in enemy or NPC behaviour. Self-determination of appropriate goals.

Evaluating	Identifying flaws (such as bias or imbalance) in the game. Comparing the game with others in the same genre.
Creating	Writing about the game (reviews or guides to playing the game). Building new levels or mods.

While such a taxonomy of learning was not intended to describe a player's engagement with a game, it is clear that playing video games involves some sort of progression from understanding to application and, for some players, on to evaluation and creation. When such a learning taxonomy is applied to games in this way, a hierarchy of a particular form is suggested: one cannot get to the point of actually playing the game until one has reached the third level of cognition and, perhaps less surprisingly, it seems likely that a relatively small proportion of players will ever attain the top two levels, meaning the majority of players must sit in the middle of the hierarchy. Further, the application of the taxonomy above focusses on what the player learns about the game itself, not what they can learn from the game that might be applicable elsewhere. However, it might be suggested that the further up the taxonomy the player moves, the more widely useful their learning becomes. Being able to recall which buttons to press in a particular game is of no utility in a wider context, but as the player moves towards the top of the hierarchy, they begin to develop analytical and critical skills which might conceivably become relevant in other situations. Certainly, by the time a player is writing about a game, or modifying it in some way, they are honing skills that are clearly transferable.

Graduate Attributes

Often referred to as 'generic attributes', graduate attributes – as the University of Glasgow and many other institutions designate them – are another way of identifying and, to some degree, quantifying the skills and competencies that students are said to develop in higher education, over-and-above those that relate directly to their degree subject. In fact, graduate attributes are most commonly aligned with the notion of the 'life-long learner' (Candy, Crebert & O'Leary, 1994): these are skills and capabilities that are developed over time, from childhood onwards. In formal education, particularly at university level, generic attributes such as critical thinking, problem-solving, and the ability to self-organise, are highlighted as skills that enhance graduates' employability. If studying for a degree can help develop these skills, so the argument goes, then graduates will be better placed to deploy and develop them in the workplace.

The Candy et al (1994) report for the Australian government identified the following characteristics of a life-long learner:

An inquiring mind

- a love of learning;
- a sense of curiosity and question asking;
- a critical spirit;
- comprehension-monitoring and self-evaluation;

Helicopter vision

- a sense of the interconnectedness of fields;
- an awareness of how knowledge is created in at least one field of study, and an
- understanding of the methodological and substantive limitations of that field;
- breadth of vision;

Information literacy

- knowledge of major current resources available in at least one field of study;
- ability to frame researchable questions in at least one field of study;
- ability to locate, evaluate, manage and use information in a range of contexts;
- ability to retrieve information using a variety of media;
- ability to decode information in a variety of forms: written, statistical, graphs, charts, diagrams and tables;
- critical evaluation of information;

A sense of personal agency

- a positive concept of oneself as capable and autonomous;
- self-organisation skills (time management, goal-setting etc.);

A repertoire of learning skills

- knowledge of one's own strengths, weaknesses and preferred learning style;
- range of strategies for learning in whatever context one finds oneself; and
- an understanding of the differences between surface and deep level learning.

As noted by Hager & Holland (2006), these characteristics are “heavily reliant on a range of generic attributes” and, indeed, this report seems to have exerted some influence on the subsequent development of graduate attributes, particularly in Australia and the UK. It is perhaps worth noting

that many of these characteristics of life-long learning are to be found in the 'best' video game players, too, particularly where information literacy (decoding information, using information from a variety of media) and personal agency (the sense of self-efficacy that games can provide, and the requirement that players manage their own goals and in-game resources) are concerned.

Moy (1999), describing what she terms the "key competencies journey", suggests that generic attributes are most readily developed through "active and interactive learning", placing emphasis on problem-solving and reflection so that "learners reflect on what has been learnt and the learning processes, as a critical aspect of competency development, self-awareness and the development of lifelong learning skills". Moy also suggests that, in order to support the development of such generic competencies, learning tasks should be relevant and meaningful to learners. It is perhaps not difficult to see another parallel with the inherently interactive video game medium here, as those who play them most avidly will certainly attest to games' relevance and meaning.

The question of whether university courses are explicitly designed to develop generic attributes is perhaps not satisfactorily answered in the literature, despite what universities and other institutions might claim. Arguably the leading researcher in the field, Barrie (2004), noted that "university teachers charged with responsibility for developing students' generic graduate attributes do not share a common understanding of either the nature of these outcomes, or the teaching and learning processes that might facilitate the development of these outcomes." So, despite institutional best intentions, it may be the case that the lack of a shared understanding of what is meant by generic graduate attributes, and how to cultivate them, is one barrier to their development in higher education. Similarly, Green, Hammer and Star (2008) note that graduate attributes can be difficult to develop due to the confusion that surrounds their definition and implementation, a problem exacerbated by institutional resistance and under-estimation of the resources required to embed related practices.

Ten years earlier, and using the term 'personal transferable skills' (PTS) rather than 'graduate attributes', Drummond, Nixon and Wiltshire (1998) identified a variety of further problems associated with embedding such practice in higher education, despite some considerable investment in PTS initiatives. They note that "effective skills development is difficult, if not impossible, to achieve in a system of teaching which is fundamentally based on lectures" and identified a lack of incentive for academics – for whom promotion and, indeed, continued employment, is dependent on research outputs and successful funding applications – to engage with new teaching practices, particularly where the teaching does not relate directly to the work on which their research career is based. The image Drummond et al project is of small pockets of good work rather than institution-

wide efforts, concluding that "isolated, *ad hoc* initiatives do not amount to effective approaches to development." Given the challenges associated with integrating graduate attribute development in research-driven curricula, which Drummond et al describe as being "difficult to operationalise effectively", another approach they identify is that of a stand-alone module or course:

> "Parallel (or stand-alone) development involves skills being developed in freestanding modules, which are not integrated into the curriculum. Some universities have accredited such schemes, e.g. student tutoring and student development programmes. Students generally do not appreciate the academic value of standalone modules. There are advantages to this approach though – not least in that the value of skills development is made explicit, and in a modular framework it allows students to involve themselves in a more varied learning experience."

Of course, stand-alone courses bring with them resourcing issues and, as Green et al (2009) note, there is evidence of "polarised student responses" to such additions to the curriculum. In an ideal situation, the development of graduate attributes perhaps should be embedded in university courses but there are undoubtedly challenges associated with doing so, particularly if the aim is to achieve parity across disciplines. If video games are already capable of developing similar attributes in players, perhaps they can be used to facilitate relatively low-cost, student-centred graduate attribute 'courses'.

However, despite the issues associated with embedding graduate attribute development, de Corte (1996) argues that the best learning environments exhibit many features that relate directly to the development of generic attributes – features that higher education institutions can, and in many cases do, encourage. According to de Corte, such environments should, for example, provide a "good balance between discovery learning and personal exploration, on the one hand, and systematic instruction and guidance, on the other" while "allowing for the flexible adaptation of the instructional support to accommodate individual differences and stages of learning" and for "social interaction and collaboration". Not for the first time, the language used to describe an optimal learning scenario is directly relatable to the design of the best video games, many of which rely on just this sort of balanced approach to learning by exploration and systematic guidance to lead players of differing experience and ability through the game. Social and collaborative aspects of learning theory (and games) are discussed in more detail below, but it seems clear that there is an argument to be made in favour of using video games as a means of helping to develop graduate attributes.

Theories of learning

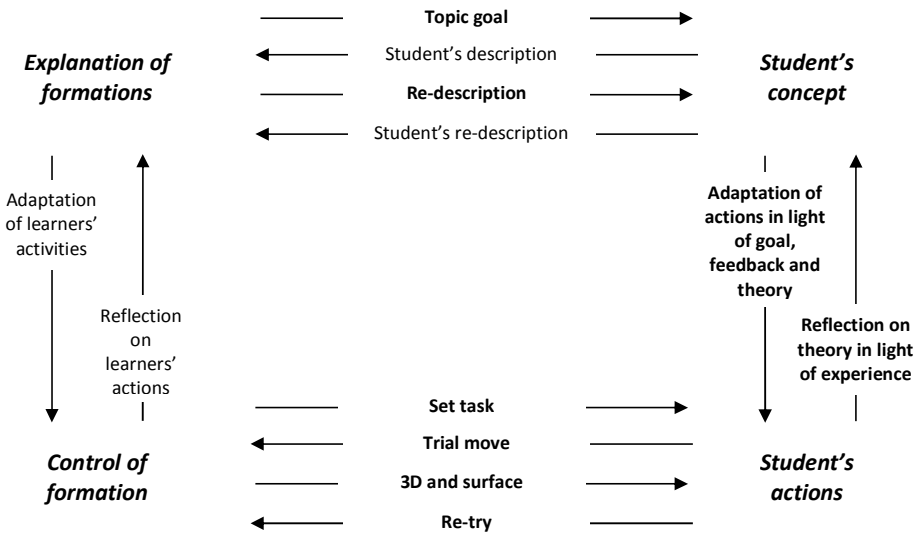
This section provides an overview of the educational theories that seem most relevant to learning from video games, formally and informally. It draws on theories of education (that is, how pedagogic content is delivered, or the practice of teaching), which seem more prevalent in earlier works, and on theories of learning (how pedagogic content is understood, or how we learn), which gain greater prominence in later literature, perhaps as a result of advances, and greater faith being placed, in our understanding of psychology and neuroscience.

Initially, it seemed helpful to divide the literature into two broad categories: instructivist and constructivist. The instructivist model presents learning as the acquisition of knowledge and is probably the form of learning – or, at least, of teaching – that anyone who has been to school, college or university has experienced the most. It is typified by the didactic image of the teacher or lecturer at the front of the class, transmitting knowledge to their students. From Pavlov's behavioural conditioning (extrapolated to great effect in Aldous Huxley's 1932 novel, *Brave New World*) to Skinner's ideas about self-instruction and reinforcement (Holland & Skinner, 1961) through to work that followed (see Carroll, 1969; Carroll, 1989; Merrill, 2002), there is seemingly no great, unifying theory of instruction. Perhaps what binds together these ideas is their pervasiveness and the fact that – where formal education is concerned, at least – the instructivist approach dominates.

There are certainly those who have written extensively about models of instruction, even if no one name is particularly associated with instructivism. Gagné (1977) identified five main types of learning: verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes. In order to meet his "conditions for learning", Gagné suggested that each of these types must be addressed by a particular form of instruction. These "instructional events" included activities such as informing learners of the objective, providing learning guidance, providing feedback and assessing performance – all elements of instruction familiar from school and beyond. Gagné, together with Briggs (1974/2005), identified a suite of internal (to the learner) and external conditions that need to be met for each type of learning to occur. For example, learning of the type referred to as "cognitive strategies" might require the internal recall of relevant concepts, while the corresponding external condition might be the learner demonstrating a solution based on those concepts. Similarly, motor skills require both an internal memorisation of component chains and external practice to hone those skills. Intellectual skills are treated somewhat differently, as Gagné and Briggs break these skills into subcategories, each with its own type of "performance" – for example, understanding of a rule can be demonstrated by applying that rule. So, while the model of instruction offered by Gagné and Briggs was intended for use in a teacher-learner environment and, as such, is not immediately

promising for the apparently more constructivist learning that games may support, there are comparisons to be made if the teacher or learning environment is replaced by a video game (which is not to preclude the use of video games in conjunction with a teacher or facilitator). Understanding and applying rules, memorising and using motor components (game controls), or applying a solution to an in-game problem based on recall of similar problems and associated strategies are all phenomena familiar to those who play video games.

Laurillard (2002a) offers a dialogic model of instruction, termed the "Conversational Framework", which identifies the activities necessary to complete a learning task in a formal education environment. Her model characterises the teaching-learning process as an "iterative conversation". This basic concept, as Laurillard herself notes, is not new: there are echoes of dialogic instruction throughout modern learning theory (e.g. Vygotsky) and the idea dates back to at least to Socrates. Laurillard states that her Conversational Framework is "not normally applicable to learning through experience, nor to 'everyday' learning" (Laurillard, 2002a: 87) but in the second (2002) edition of *Rethinking University Teaching*, the author includes educational video games as a form of adaptive media – alongside virtual environments and simulations – which may be modelled using the Framework. The figure below shows how Laurillard interpreted the Conversational Framework for a geology simulation designed to teach students about rock formations. As an example of adaptive media, not so far removed from a game, this interpretation offers some suggestion of how the Framework might be applied to an educational game, although, as Laurillard concedes, this simulation-based interpretation is not tremendously discursive.



The geology simulation is able to adapt the feedback given to a student based on their activities, but this is limited to the regurgitation of the same canned text that may have introduced the topic. It is tailored to the student's actions, to a degree, but it is not especially dynamic. This is one area in which video games can excel, as commercial titles are already capable of dynamically adjusting game difficulty in response to player performance (Hunicke and Chapman, 2004; Andrade, Ramalho and Santana, 2005), as well as offering video tutorials to players after detecting a series of failed attempts to traverse an area (as in the more recent *New Super Mario Bros.* releases from Nintendo).

Laurillard is broadly optimistic about the use of video games in formal education (although her focus is on educational titles rather than commercial games), noting that their strengths include the "intrinsic feedback" (Ibid. 143) that games offer, and the "real-time nature of the interaction, because this requires close attention and responsiveness from the user, whether it is a combative game, or an environment that changes over time". Laurillard also notes multiplayer games' potential for use as interactive, social environments, and that goals can be program-defined (i.e. set by the game), or player-defined as in certain open-world titles, or construction simulations. It is worth noting, however, that the first edition of Laurillard's book talked about intelligent tutoring systems (ITSs) with similar expectation, and she cautions here that educational games might be "another chimera", unlikely to live up to their pedagogic potential as a result of market forces – that is, there is very little money in educational games, compared to the multi-million dollar blockbusters that (used to) line the shelves at Woolworths. This is a common concern, and while games backed by the US military (as described in a later section), can match the production values of *Call of Duty* and games of that calibre the more fertile ground for educational titles is perhaps in the web or mobile space, where effective games can be developed for much more modest budgets. The other possibility, of course, is to appropriate existing commercial games for educational purposes (see again Squire, 2004; Miller and Robertson, 2011) and harness the big games publishers' budget for pedagogic benefit.

Broadly speaking, the constructivist model suggests that learning should be rather more self-directed, with the learner more actively assembling or constructing knowledge rather than receiving it from the teacher, by completing tasks and thinking for themselves. The teacher is perhaps more of a facilitator whose role is to administer tasks within which the learner can construct their own meaning and, in this sense, constructivism might be considered a more individualistic approach to learning than its instructive counterpart. Constructivism and related concepts and theories are discussed in more detail below.

However, it became apparent that this convenient classification was not entirely appropriate. Skinner (who, incidentally, lends his name to *The Simpsons'* Principal Skinner), for example, also stated that "to acquire behaviour, the student must engage in behaviour" (Holland & Skinner, 1961: 389) which sounds rather more like an active process of learning than the passive picture that his broadly instructivist views suggest. Also, while there must be some instructional element to learning from video games, constructivism and its related concepts are, perhaps, more relevant to this thesis. Therefore, devoting equal attention to both schools of thought seemed inappropriate. Herein lays another issue encountered with trying to divide the literature into two crude categories: the term 'constructivism' does not necessarily incorporate ideas of learning by doing or discovery learning, which seem relevant to games and certainly do not fall within the instructivist purview. Further, constructivism comes in many flavours, a point illustrated by the comparison of Piaget and Papert that follows. There are also learning theories and paradigms that do not readily fall into a single school of thought, and numerous other attempts to group and categorise views on learning.

Mayes & de Freitas (2006), for example, of three "perspectives on the nature of learning itself", actually based on the three views of educational design identified by Greeno, Collins & Resnick (1996), which considered each view in terms of: designing learning environments, formulating curricula, and constructing assessments. Mayes & de Freitas, as part of an e-learning models desk study, present these three views as follows:

> The *associationist/empiricist* perspective (**learning as activity**)
>
> The *cognitive* perspective (**learning as achieving understanding**)
>
> The *situative* perspective (**learning as social practice**)

From the *associationist* perspective, the focus is on "routines of activity for effective transmission of knowledge" (Greeno et al, 1996), aligning such views with instructionists such as Gagne. However, the associationist approach is not at odds with constructivism: learning-by-doing is to be embraced. Clear goals, feedback and reinforcement are all thought to be advantageous or, as Mayes & de Freitas phrase it, "learning is the formation, strengthening and adjustment of associations, particularly through the reinforcement of particular connections through feedback". Where this perspective can seem outdated is in its assumption that learning must take place in a "bottom-up" fashion, with small, less complex units of knowledge or understanding eventually, and sequentially, building towards an understanding of a more complex whole. However, as Mayes & de Freitas note, this is exactly the approach taken in the majority of today's e-learning resources.

The *cognitive* perspective, also referred to as the *rationalist* view by Greeno et al, relies upon the development of an understanding of the learned material, drawing on cognitive tools such as memory, reasoning and problem-solving ability. According to Mayes and de Freitas, the "underlying theme for learning is to model the processes of interpreting and constructing meaning", such that knowledge acquisition may be viewed as the "outcome of an interaction between new experiences and the structures for understanding that have already been created."

The *situative* view, which Greeno et al originally termed the *situative/pragmatist-sociohistoric* view introduced the social aspects of learning, acknowledging the influence of "the social and cultural setting in which the learning occurs, which will also define at least partly the learning outcomes" (Mayes & de Freitas). This perspective, as described by Greeno et al, sees the learner develop their own personal identity within a group, or community of practice, while engaging in learning activities that focus not only on the subject matter at hand but also on cooperation and communication. Social learning is discussed in more detail below, but one of the most significant facets of the situative view is in the "importance of context-dependent learning in informal settings". As well as social interaction, the situative view is dependent on an authentic context in which to carry out the practice of learning.

What follows is an overview of the learning ideas and concepts most applicable to game-based learning, with some analysis of the value of each.

Constructivism

Constructivism refers to the active process through which the learner may themselves construct new knowledge, by applying existing knowledge to new problems. Describing what he terms "radical constructivism", Glasersfeld (1995, p.18) states that "knowledge, no matter how it be defined, is in the heads of persons, and that the thinking subject has no alternative but to construct what he or she knows on the basis of his or her own experience." Bruner (1960, p.17) states that prior learning "renders later performance more efficient" through "what is conveniently called nonspecific transfer or, more accurately, the transfer of principles and attitudes". In this way, Bruner argues, such learning "consists of learning initially not a skill but a general idea, which can then be used as a basis for recognizing subsequent problems as special cases of the idea originally mastered."

Savery & Duffy (1995) characterise constructivist learning environments in terms of what they consider the "philosophy" of constructivism, but also offer a number of instructional principles that support this philosophy. Their philosophical propositions are as follows:

1. Understanding is *in* our interactions with the environment

2. Cognitive conflict or puzzlement is the stimulus for learning and determines the organization and nature of what is learned
3. Knowledge evolves through social negotiation and through the evaluation of the viability of individual understandings

Savery & Duffy consider the first of these propositions to be the core concept of constructivism (that's their emphasis on the 'in'). Indeed, this this seems a neat summation of the idea, but the second and third components are also useful, and serve to illustrate constructivism's close coupling with the sort of learning games can stimulate. What is a game without some "cognitive conflict or puzzlement", after all? Related to this point, Savery & Duffy also note that "it is the goal of the learner that is central in considering what is learned", which aligns with another aspect of video games: that they – to varying degrees – permit the player to set their own goals or, at least, attempt to tackle the game's challenges at their own pace. In their third proposition, it is interesting to note the importance that the authors place on social aspects of learning – these are discussed in more detail below, and their relevance to games considered.

As noted in the introduction to this section, 'constructivism' is not a clearly delineated concept, and nor can it be attributed to a single scholar. Alongside Dewey (1938), and Montessori (1949), Piaget (1956) and Papert (1980), for example, are two of the names most closely associated with constructivism in the literature. However, even their ideas about constructivism are not identical: Papert suggests the modified term 'constructionism' which, like the constructivism described by Piaget, builds on the concept of learning as "building knowledge structures" while also adding "the idea that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it's a sandcastle on the beach or a theory of the universe" (Papert & Harel, 1991). Piaget and Papert are both constructivists, then, but Papert is also something else and it might be problematic to assume that 'constructivism' carries the same meaning for all when applying it to video games, or any other pursuit.

A further issue associated with some of the seminal work produced on constructivism – especially that described by Piaget and Papert – is that it is very much focussed on children and is mostly only applied to adults by extrapolation. While this thesis is concerned primarily with video games' effects on adults, it does, however, also aim to investigate retrospectively the pedagogic effects that playing games as children has had on today's adults. It should also be noted that Piaget's theories have been successfully adapted and applied to tertiary level education (e.g. Wankat & Oreovicz, 1993).

In gaming terms, one could see constructivism taking on one of several meanings. First, it might refer to the learning that occurs as a player turns their attention to the process of developing their own game, or perhaps more commonly, creating their own modification or extension of a game, or using built-in tools to construct new levels or in-game items. While the player here is undoubtedly drawing on their existing experience of playing video games – they must possess some understanding of the form and conventions associated with games before they may construct their own – this is a highly literal application of the constructivist concept (see also 'Players as producers' below). A more subtle interpretation might also include the process of learning to play a game based on previous gaming experience, and also on real world experience: games are conceived and designed in the real world, even if their settings or themes are other-worldly, and so our understanding of the world around us may also be used to inform our play. This idea may be taken further, and reversed; in learning about the world around us, may we not, in constructivist terms, draw upon experiences gained through video games? Online interactions with other players, for example, may serve as an allegory for effective communication in the real world.

If learning through constructivist means relies upon prior experience, then the recollection, or retrieval, of memories associated with such experience is an important factor. Karpicke & Blunt (2011) state that "because each act of retrieval changes the memory, the act of reconstructing knowledge must be considered essential to the process of learning", demonstrating that "retrieval practice is a powerful way to promote meaningful learning of complex concepts". In showing that practicing retrieval is as effective, or more so, than elaborative learning techniques (such as the drawing of concept maps while studying the source material) Karpicke & Blunt's work suggests that the act of recalling what we have learned is as important as how we store this information in the first place. It is conceivable that, at a low level, video games may also excel at providing players with reason to practice such retrieval, leveraging the same effects that Karpicke & Blunt demonstrate, in order to teach players how to play. When a new game concept is introduced – for example, a new skill or ability that your player character obtains – this new knowledge is not typically intended to be stored away for later use, to be examined by means of an in-game test at some point in the possibly distant future: instead, the player is usually expected to start retrieving this knowledge almost immediately, and often repeatedly, until it becomes second nature. The player may have constructed their own knowledge by observing the mechanics of the new game concept – it is not necessarily spelled out for them – but it is in the repeated act of retrieval that they truly understand how to apply it.

Related to constructivism, the concept of contingent tutoring relies upon the learner to apply existing knowledge to address some new problem, with the tutor providing only the help necessary for the learner to succeed, and doing so at just the moment it is required. Wood et al (1978) offer the following 'contingency rule': "If the child succeeds, when next intervening offer less help. If the child fails, when next intervening take over more control." According to Wood et al, contingency tutoring to work, any instructional comments must related directly to the behaviour observed in the learner. It might be argued that successful modern video games also draw on contingent tutoring – to a limited degree – in order to ensure that players have new concepts (e.g. the workings of a new in-game mechanic, ability or weapon) explained to them at just the right time and in just enough detail. However, for the most part, games do not actively monitor individual players' actions and therefore cannot offer contingent intervention that relates directly to their actions. While some games offer the player helpful hints when repeated failure is detected, such crude measures are at the fringes of what might be considered contingent tutoring, and lack the subtlety and responsiveness that human interaction between learner and teacher (or child and parent, as observed by Wood et al) can provide. Video games might be better described as providing an experience that is more closely related to scaffolding, discussed below (see also the discussion of dynamic difficulty adjustment under 'Learning from commercial video games').

Experiential learning

The Chinese philosopher Confucius is mistakenly assumed to have coined the following phrase, which, aside from its dubious origins[4], neatly summarises experiential learning:

> *"Tell me and I will forget,*
> *Show me and I may remember,*
> *Involve me and I will understand."*

It is Dewey who has been credited as the "modern father of experiential education" (Neill, 2005). Dewey was among the earliest of the modern writers to consider the conflict between what he considered the two extremes of education: the 'traditional', didactic, teacher-led approach versus the more progressive, less structured student-led approach (Dewey, 1938). For Dewey, good educational design took into consideration the learner's place in society; how they might contribute to it, and how they – as an individual – experienced it. Every learner's experience will be different, and the best learning environments (and teachers) should be able to adapt to these differences.

[4] A version of this phrase may originate with Xun-zi (Hsüntze ,312-230 B.C.) http://dakinburdick.wordpress.com/2012/03/14/tell-me-and-i-forget/ (accessed 2 November 2013)

Dewey's followers and the experiential learning cycles they have developed have perhaps been still more influential. Kolb's (1983) learning cycle and associated model of learning is the most widely cited of these, and builds directly on Dewey's work (and on that by Piaget):

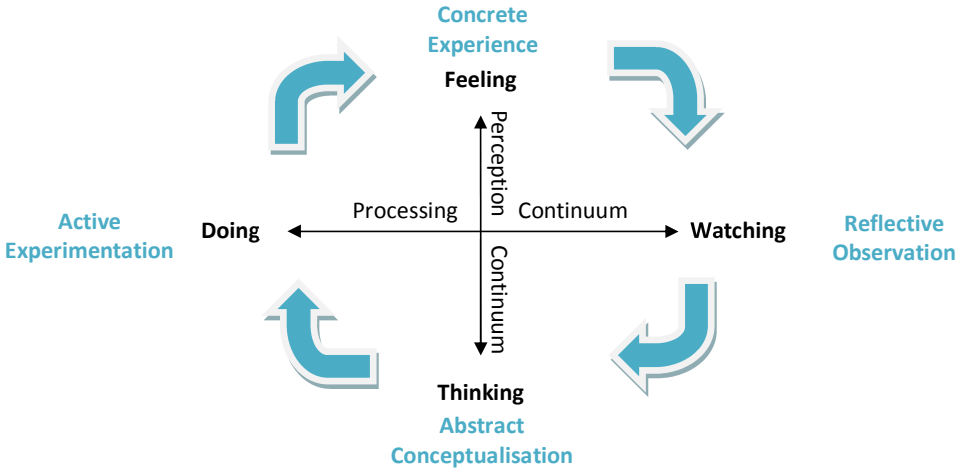


Figure 5: Kolb's Experiential Learning Model & Cycle (adapted from Kolb, 1983)

At the ends of both continuums are stages in the learning cycle, which the learner may enter at any point. Using video games as an example, the cycle might be illustrated as follows:

- Active experimentation (doing): Picking up a controller or mouse and simply playing the game.
- Concrete experience (feeling): Playing through the tutorial level or equivalent, following specific guidance such as in-game prompts.
- Reflective observation (watching): Thinking about what happened as you played the game, having observed what occurred in response to your input.
- Abstract conceptualisation (thinking): Consulting a game guide, wiki or online forum to determine possible strategies.

For effective learning to occur, Kolb states that a balance must be struck between the opposing ends of both continuums, for example, between active experimentation (having a go at playing the game) and reflective observation (thinking about what happened as you played).

Social learning

Like many theories of social learning, Lave and Wenger's (1991) communities of practice (which have a great deal in common with Gee's affinity spaces – see below) are also somewhat rooted in the constructivist camp. Wenger (2006) defines communities of practice as "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly", that is, a manifestation of social learning. Such communities comprise three elements: a domain of knowledge, a community of people, and some notion of shared practice. The domain might be anything – including video games or a specific game – but the people involved must share an interest in that domain, and the shared practice must be appropriate to the domain at hand. Of particular relevance to this thesis is the idea that the community of practice need not to have formed with the intention of learning about a particular domain. Any learning that does take place can be entirely incidental.

In much of the more modern literature, it is often difficult to separate the social or, at least environmental, influence exerted on learning, in both formal settings and informal groups. Related to how Dewey places such emphasis on the learner's previous experience, Vygotsky (1930/1978) also suggests that how we learn is dependent on earlier learning and also on the cultural norms to which we are exposed. Moreover, Vygotsky sees learning as an inherently social process, dependent on interaction with teachers (or adults, in Vygotsky's terms – much of his work is concerned with learning in children) and peers. His suggested 'zone of proximal development' is defined as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (1930/1978, p.86). The learner's zone of proximal development will evolve over time as they internalise and understand more complex ideas and, as such, one can see how this concept can be applied to adults – learning something new or more complicated than what they have previously learned – as well as children.

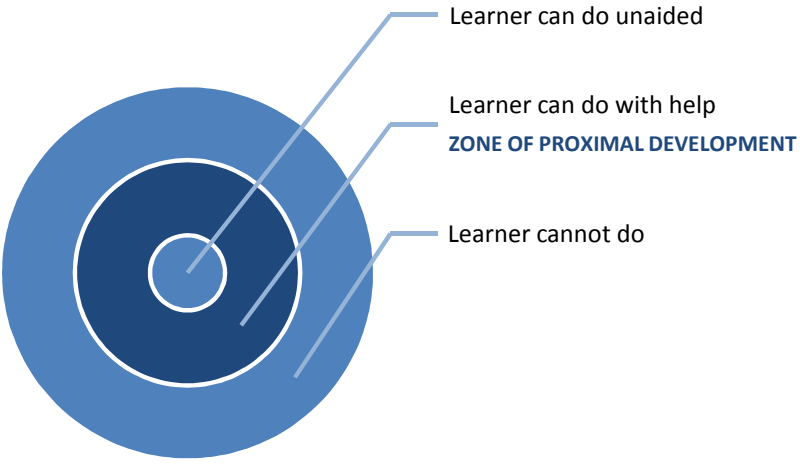


Figure 6: Vygotsky's Zone of Proximal Development (adapted from Vygotsky, 1930/1978)

In gaming terms, these social interactions might be with a more experienced player in the same room, a group of peers playing online, or, perhaps, an NPC (non-player character) providing instruction within the game. Indeed, when games fail to take into account the player's zone of proximal development, such in-game instruction can quickly become tiresome[5].

Scaffolding

Vygotsky's zone of proximal development leads naturally to the concept of 'scaffolding', a concept attributed to Bruner, who describes the need to ask a pupil "medium questions" (1960, p.44) which are answerable, based on the pupil's current level of understanding, but which point to the next, more difficult concept. Scaffolding – sometimes referred to as 'instructional scaffolding' – has been defined as a "process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts" (Wood, Bruner and Ross, 1976). Wood et al take into account the social context of learning and also the role of a tutor, that is, the adult or expert in the room, responsible for the learners' progression towards a successful outcome. They continue: "scaffolding consists essentially of the adult [or expert] 'controlling' those elements of the task that are initially beyond the learner's capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence. The task thus proceeds to a successful conclusion". The scaffolding metaphor also implies that as successful completion of the task nears, the scaffolds are gradually removed and the learner – as with a shiny new building – is left to stand alone. In video games, the tutor may take many forms, from the occasionally irritating NPC that

[5] Navi, the player's in-game companion and guide throughout the otherwise venerable *The Legend of Zelda: Ocarina of Time* (Nintendo, 1998), is one example of the game designers intruding on the player's zone of proximal development.

guides the player through initial concepts, to more subtle clues and direction peppered throughout the game by its designers. However, the scaffolding is plainly there to see for anyone who looks for it. It might be argued that the scaffolding in a good video game *should*, in fact, be all but invisible to the player and it is certainly the case that the best games keep the player just within their range of competence - see the discussion of Gee's (2003) 'Regime of Competence Principle' below.

Mastery Learning

Master learning or 'learning for mastery' is a concept most widely attributed to Bloom (1968/1971), who was critical of conventional schooling and its apparent failure to cope with differing levels of ability within a single class (see also Illich's 'Deschooling Society'). So, while Bloom estimated that over 90% of students had the potential to master a given topic, in reality a much smaller proportion of the class will fulfil this potential: "the problem of developing a strategy for mastery learning is one of determining how individual differences in learners can be related to the learning and teaching process" (Bloom 1968/1971). Mastery learning has much in common with the concept of instructional scaffolding, in that learners are provided with adequate assistance as they work towards mastering a topic. Mastery learning acknowledges that individual learners will require more or less time on each topic but, as Bloom suggests, the vast majority of learners can achieve mastery, should they be granted sufficient time and opportunity to do so. Everyone in a class is working towards achieving the same goal, but the instruction afforded each individual (or groups of individuals) is varied as required. Other key aspects of mastery learning are frequent assessment (Slavin, 1987) and prompt formative feedback (Guskey, 2007): while learners must demonstrate a certain level of mastery in the assessment associated with one topic before moving onto the next, each assessment results in useful, prescriptive feedback that the learner can use to improve their understanding and advance towards mastery.

The parallels between mastery learning and how video games are designed are quite obvious here, and quite striking. Most video games are designed to appeal to a wide range of players and must therefore take into account an equally wide range of abilities. There can be little doubt that the 40.23 million people[6] who bought the original *Super Mario Bros.* (Nintendo, 1985) did not demonstrate comparable skill in playing it but, despite this huge range of abilities, many, if not most, of these 40 million players were at least able to master the first few levels of the game. *Super Mario Bros.* is an extreme example – although, by virtue of being 'packed in' with most Wii systems, *Wii Sports* (Nintendo, 2006) has shipped over 81 million copies, according to Nintendo's own financial

[6] According to the Guinness World Records (accessed via http://web.archive.org/web/20060317005503/http://www.guinnessworldrecords.com/content_pages/record.asp?recordid=52404 May 2013)

statements[7] – but with top-selling games regularly being sold to many millions of players it is reasonable to assume that the range of abilities for which games must cater is larger than any classroom. Further, a typical game requires the player to master a level before advancing to the next, and this quest for mastery is aided by almost constant, largely useful feedback on the player's actions. This feedback may simply take the form of your on-screen avatar falling to his or her death due to the misappropriation of some in-game tool or a badly-judged leap, or it may be delivered by much more complicated means more akin to a spread sheet that details every aspect of the player's performance. Regardless of the form that this feedback takes, it is abundant, promptly delivered and frequently designed to help the player master the game.

Video games and learning

The connection between video games and learning is by no means universally agreed. Sensationalist and ill-informed commentators offer opinion on both sides of the argument but, for the most part, such contributions to the argument are nothing more than that: opinion. In 2006 Boris Johnson, then the UK's Shadow Minister for Higher Education, offered the following analysis of video game players:

"They become like blinking lizards, motionless, absorbed, only the twitching of their hands showing they are still conscious. These machines teach them nothing. They stimulate no ratiocination, discovery or feat of memory — though some of them may cunningly pretend to be educational."

While video game enthusiasts were quick to decry Johnson's comments, they illustrate an important issue with video games' image, particularly among those who, like the former Shadow Minister for Higher Education, have never played them. However, while Johnson has little basis on which to make his claims about games' lack of utility for learning, those who argue the opposite frequently lack the evidence to support their own, equally emotive and largely unsubstantiated claims. One of the names most closely associated with the pro-games-for-learning argument is Marc Prensky, whose books (such as 2001's *Digital Game-Based Learning* and the 2006 *Don't Bother me Mom – I'm Learning!*) and other writings have established him as something of an authority on games for learning. He is the founder of the commercial company Games2 train[8] – which offers "serious training in a game environment" to clients including the US Department of Defense and Microsoft – and has featured in many mainstream publications including the New York Times. Prensky is not, however, a researcher or academic. While his populist ideas echo many of those to be found in the more academic tranches of game-based learning, and his writings have enjoyed the approval of established scholars such as James Paul Gee and Henry Jenkins, Prensky's enthusiastic arguments in

[7] Financial Results Briefing for the Nine-Month Period Ended December 2012. Nintendo. http://www.nintendo.co.jp/ir/pdf/2013/130131e.pdf#page=7 (accessed May 2013)
[8] http://www.games2train.com/ (access October 2013)

favour of using video games in schools or as part of an "at home curriculum" (2006, p.213) are still largely conjectural. Caution, therefore, is required when reading such material: Prensky and those with similar feelings and intuitions (including Steven Johnson, author of the 2005 book *Everything Bad Is Good for You*) are writers, not researchers, and citing their work could, arguably, weaken any argument in favour of games' positive effects on learning.

Serious games and 'edutainment'

For as long as there have been computers in classrooms, video games have been developed with education in mind; frequently branded as 'edutainment', the term neatly summarises the conflicting interests inherent in developing games solely for education. Too often edutainment titles have focussed on the game at the expense of the educational content, or vice versa, resulting in games that are educationally worthy but cannot hope to engage the player, or somewhat enjoyable titles that sacrifice pedagogic value in the name of fun. As the MIT-based scholar Seymour Papert suggests in an article entitled 'Does Easy Do It? Children, Games & Learning' (1998, p.88), this "mating of education and entertainment" has produced "offspring that keep the bad features of each parent and lose the good ones".

There are, however, examples of educational games that are cited as successful implementations within the genre. *Oregon Trail*[9] by Don Rawitsch, Bill Heinemann and Paul Dillenberger is familiar to several generations of North American students. Aimed at elementary school children, the game simulates the struggle faced by pioneers as they made the trek west to Oregon in the mid-19th century. Featuring brushes with dysentery and some of the harsher realities of pioneer life, *The Oregon Trail* paints a vivid picture of an historical setting and succeeds as an educational game, first because children enjoy playing it (the on-screen message "You have died of dysentery" remains a popular meme and cultural reference point amongst former players); and second, because learners are immersed in a well-researched and engaging simulation that presents an opportunity to empathise with the historical characters, and think from their point of view, while exploring the geography of the infamous migration route. Originally developed in 1971 and published for the Apple II computer in 1978, versions of the game are currently available for Apple iOS (iPhone, iPad), Nintendo DS and Wii.

Other notable examples of educational games that have garnered praise or enjoyed continued success include:

[9] http://www.oregontrail.com/ (accessed August 2012)

Math Blaster.[10] An intergalactic adventure that aims to teach mathematics to school-age children, first launched in the US in 1987. Now available in various forms across a range of modern platforms, including PC, iOS and Nintendo DS.

The Typing of the Dead.[11] Sega's unholy melding of the on-rails (i.e. you don't control your character's movement) first-person perspective zombie shooter genre with a typing tutorial is, at the very least, a cultural curio. It appeared in game arcades in 1999 and was later ported to Sega's own Dreamcast console, PC and Sony PlayStation 2. Most recently, a spin-off of the game entitled *Flick of the Dead*[12] was released for Japanese iOS devices.

Where in the World Is Carmen Sandiego?[13] Originally released by Brøderbund Software in 1985, this was a humorous geography-based adventure that led to series of sequels, a TV show and frequent rumours of a movie adaptation. Learning geographical facts is the key to solving the mysteries presented to the titular heroine.

Relatively small-scale, often web browser-based educational games continue to be developed today. In the United Kingdom, for example, public-funded broadcasters such as the BBC[14] and Channel 4[15] actively commission games for learning, aimed principally at primary and secondary school students.

Other game titles fall into something of a grey area in terms of classifying them as educational. Will Wright's *SimCity*[16] was first released in 1989 by Maxis and is a useful illustration of a game that, on paper, could be the exemplar of educational game design. It simulates, and asks players to understand, the complex interactions that drive a modern city: everything from energy and pollution, to taxes and civil disobedience (and giant monster attacks) is modelled in the *SimCity* games and, importantly, the experience is fun. *SimCity* is probably the game that has most influenced my own thinking on learning from video games. Given that the game, in its various iterations, has sold millions of copies and spawned the even more successful *The Sims* franchise[17], it is conceivable that many others have learned from, or been inspired to learn by, Will Wright's city simulator.

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[10] http://www.mathblaster.com/ (accessed August 2012)
[11] http://uk.gamespot.com/the-typing-of-the-dead/ (accessed August 2012)
[12] http://andriasang.com/con0xz/flick_or_die/ (accessed August 2012)
[13] http://www.carmensandiego.com/ (accessed August 2012)
[14] http://www.bbc.co.uk/schools/gcsebitesize/games/ (accessed July 2012)
[15] http://www.channel4learning.com/ (accessed July 2012)
[16] http://www.simcity.com/ (accessed August 2012)
[17] http://thesims.com/ (accessed August 2012)

Educational games are generally considered to fall under the umbrella of 'serious games', because they are developed for some purpose other than entertainment. Closely related to educational games are those titles developed to provide more vocational training and those that are intended to raise awareness of some specific issue, or improve aspects of the players' lives in other ways. Games for health, in particular, have received increased attention in recent years, with key examples including *Re-Mission*[19]: a game designed to help young people with cancer cope with their illness and, it is claimed, improve remedial outcomes. Other serious games with humanitarian intentions include *Darfur Is Dying*[20], directed by Susana Ruiz and produced as part of the Games For Change initiative[21] to raise awareness of the issues in the Darfur region of Sudan.

More controversial, perhaps, are games developed as propaganda or recruitment tools for the military, such as *America's Army*[22] — a free-to-download video game designed to recruit (and eventually train) young people for the US Armed Forces. *America's Army* stands out among serious games as a result of its high production values: it was built using the commercial Unreal Engine[23] that also powers many of the last decade's top-performing and most critically-acclaimed blockbuster games, including Bioware's *Mass Effect* series, Rocksteady's *Batman: Arkham Asylum* and *Arkham City*, and Epic Games' *Gears of War* titles. Featuring rather less accomplished visuals and gameplay mechanics, *Quest For Bush* (Vargas, 2006) was released by the Global Islamic Media Front in 2006, and sees the player tasked with hunting down and killing US president, George W. Bush, and British Prime Minister of the time, Tony Blair. While this title is obviously considered controversial, particularly in America, it's worth noting that it is, in fact a 'mod' (modification) of a legitimately-released US title, *Quest for Saddam*[24].

Motivation

It is often implied that video games' ability to support learning lies in their power to motivate individuals (and groups thereof) to play them. As Gee (2008) notes, "lots of young people pay lots of money to engage in an activity that is hard, long, and complex", and the appeal of video games does not seem to lessen with age. The generations who have grown up with games — and continue to play them well into their adult years — will attest to games' ability to motivate where their day job or other adult responsibilities do not. As noted previously, the average age of those who regularly

[18] http://www.re-mission.net (accessed January 2012)
[19] http://www.re-mission.net (accessed January 2012)
[20] http://www.darfurisdying.com/ (accessed January 2012)
[21] http://www.gamesforchange.org/ (accessed January 2012)
[22] http://www.americasarmy.com/ (accessed January 2012)
[23] http://www.unrealengine.com/ (accessed August 2012)
[24] http://www.imdb.com/title/tt0400759/ (accessed August 2012)

play games is believed to be in the 30s: it seems a reasonable assumption to make that games motivate people of all ages to play them.

The motivation to learn – for learning's sake – is perhaps more elusive. Garris et al (2002) describe the motivated learner as follows, while noting that such learners are hard to find and even more difficult to create:

> "They are enthusiastic, focused, and engaged. They are interested in and enjoy what they are doing, they try hard, and they persist over time. Their behavior is self-determined, driven by their own volition rather than external forces."

In the context of game-based learning, the nature of games' motivational properties is not so readily described. Broadly speaking, the psychology and education literature refer to two forms of motivation: intrinsic motivation, where the task at hand provides its own reward, and extrinsic, where the motivation is driven by the desire for external rewards such as money or prizes, or recognition from one's peers. On the one hand, video games appear to offer the ultimate intrinsic motivation, as players pick up and play games simply because they are fun. Enjoyment, and thus motivation, can be derived from tackling the challenge inherent in a game or, at least, from the game's ability to provide diversion or distraction from other concerns. On the other hand, there are a number of aspects to gaming which complicate the issue, by introducing motivation that is clearly extrinsic. Chief among these aspects is the element of competition. Many of the most popular games of the last decade, from Nintendo's living room-bound *Wii Sports* to the online multiplayer of Activision's *Call of Duty* series, have thrived on players' thirst for competition and the wholly extrinsic motivation that beating a fellow player provides (Vorderer et al, 2003). Competition is all the more compelling a motivator in an era when gaming 'achievements' (to use the Xbox or Steam nomenclature; on PlayStation the equivalent rewards are named 'trophies') are published online for friends to see.

However, Malone and Lepper (1987) suggest that intrinsic motivation is the more powerful force in terms of learning from and engaging with games. This idea is borne out by the more recent findings of Hainey et al (2011) who studied the motivations of gamers at higher education level, while making distinctions between those students who played online or offline games, and those who preferred to play alone (single player) or with others (multiplayer). While differences were identified between these different groups, overall the study found that an intrinsic motivation – challenge – was the top-ranking factor, while the rather more extrinsic motivation of recognition was least important.

Writing about what made early computer games (such as *Breakout*) fun, Malone (1981) suggested that the primary motivational factors are intrinsic, and comprise challenge, curiosity and fantasy. Malone & Lepper (1987) later updated this model to include a fourth individual factor, control, and three inter-personal factors: cooperation, competition and recognition. As noted by Hainey et al (2011), the presence of these same factors is equally important in the design of a good video game as in any learning environment. Thiagarajan (1996) identified five (conveniently alliterative) motivational characteristics of video games, in a vein similar to Malone & Lepper's factors. These comprise: conflict, which may incorporate both competition and cooperation with fellow players or game-based actors; control, working within the rules of the game; closure, or the ability to reach some end-point; contrivance, meaning the game is clearly 'just' a game; and competency, as the player's problem solving and other skills improve with practice.

Based on the work of Malone & Lepper and others, Garris et al (2002) settled on six dimensions which may be used to characterise the motivational aspects of any game and "provide a common vocabulary for describing and manipulating the core elements of games for instructional purposes": fantasy, rules/goals, sensory stimuli, challenge, mystery and control. Further, these six motivational dimensions are framed by what Garris et al refer to as "the game cycle", which features repeated iterations of user judgements (self-determined levels of interest and engagement, enjoyment, and feelings of mastery), behaviour (sustained game play) and feedback (knowledge of results, as provided by the game). User judgements can also include feelings of confidence which, according to Bandura & Wood (1989), may transfer from an in-game setting to real-world scenarios where similar skills may be applied. Skills learned (and confidence gained) from leading a guild in the MMORPG *World of Warcraft*, for example, might prove useful in leading a team in a real-world work environment. Garris et al also note that confidence may be afforded by playing out scenarios within a game where there are no "real-world consequences of failure" (another point echoed by Gee – see below), allowing players to learn by experimentation in a risk-free environment. Finally, it is stated that while "feedback or knowledge of results is critical to support performance and motivation" the meta-analysis of Kluger & DeNisi (1996) suggests that feedback on some tasks can actually have a negative effect on performance.

Bartle (1996, 2003), originally looking at those who played games in the MUD (Multi-User Dungeon) genre, which he helped define, identified four basic player types:

- Achievers, who wish to act on – or leave their mark on – the virtual world by achieving goals defined by the game

- Socializers, for whom the virtual worlds offered by games are a medium through which they can interact with other players, often in the guise of some role they play within the game
- Explorers, who wish to explore and understand the game world by interacting with it
- Killers, who wish to act on – to kill, attack or otherwise antagonise – other players.

If a game is to be widely successful, Bartle suggests that all of these player types must be provided with relevant gratification to motivate them. In some ways there are echoes of Gagné and Briggs's (1974/2005) learner types here, each of which must be catered for in a successful learning environment. If learning really is synonymous with learning, then perhaps we should be examining how we keep Bartle's 'killers' et al satisfied in formal education.

While there is a general consensus in the literature that games' intrinsically (or extrinsically) motivational properties make them ideally suited for use in education (see Becker, 2001; Garris et al, 2002; Oblinger, 2004; Miller & Robertson, 2010), Whitton (2007) cautions against making such assumptions. Whitton notes that not everyone is motivated to play games, or to learn from them, and that the supposition that games are inherently motivating is probably propagated by factors of self-selection in gaming studies and researchers' personal interest in games. These are very valid points, not only when considering the use of video games in formal educational but when, as in the case of this work, considering what it is about games that might have led to learning from them incidentally. Any conclusions drawn about the learning potential of video games, even if that learning is happening without the conscious acknowledgement of the player, must consider that games' power to motivate players is not universal. Further, one must consider the limitations of motivation as an argument in favour of games' usefulness for learning. An issue that the literature seems to avoid, to some degree, is that being motivated to play a game is, on its own, not enough. Many games, at least without additional context or scaffolding, do not lend themselves to useful learning.

Co-operation, collaboration and competition

Another key aspect of gaming that may warrant closer inspection in the context of learning is the collaborative nature of the experience. Building on the process of 'collaborative problem solving' described by Nelson (1999), Wiley & Edwards (2002) identified the innovative use of existing technologies (HTTP, the World Wide Web) by decentralised groups to collaborate and share knowledge and resources. The examples cited include the file-sharing application Napster and the still-popular, user-moderated technology news website, Slashdot. Applying these ideas to learning,

Gee (2005) describes a phenomenon he calls 'affinity spaces', or online groups that voluntarily gather to learn. The literature suggests that such groups exist in both the online and the real, physical world. One interesting, if somewhat anecdotal, example of where a real-world 'affinity space' grew up around learning from video games comes from Squire's (2004) efforts to teach social history to a group of under-performing teenagers using the historical strategy game *Civilization III* (often known simply as *Civ*). Squire provides an account of how a number of unengaged and disinterested high school students became involved in playing *Civ* as part of their social studies class (which many had already failed, repeatedly). A large proportion of these students ended up being able to discuss their strategies, the strengths and weakness of ancient civilisations and the limitations of *Civ* as a system, including the possibility of bias. At the culmination of Squire's efforts with a particular group of students, he ran a summer programme ('Civ Camp') where students volunteered to compete against their tutors, and each other, in a series of *Civilization* games. Squire and the other tutors later discovered that one of the students — who had initially dismissed the idea of learning from *Civ* — had organised a sleep over at his home the night before the tournament began. The purpose of this clandestine meeting was to plan, with the help of a world map and other 'academic' materials, how the students might defeat their tutors over the thousands of years of human history. They applied lessons learned from historical accounts, a new-found appreciation of geography and an understanding of the game as a system to devise a strategy for winning. This ostensibly academic work was undertaken by the students of their own volition and in their own time, in stark contrast to the approach typically taken to homework assignments. Many of these students have gone on to embark on interesting, often academic careers. That playing *Civilization* might have steered them on this course is a potentially useful example of how video games can inspire learning, but the small class size and somewhat atypical circumstances (the failing students involved had little lose by playing the game) mean that the results reported by Squire are not necessarily reproducible.

Learning from commercial video games

In the popular *A Theory of Fun for Game Design*, Koster states bluntly that "learning can be problematic" (2005, p.110). He highlights the human predilection for cheating or, at the very least, finding the easiest means of solving a problem; this he likens to solving an algebraic problem without writing out the proof, or 'showing your working'. Acknowledging that complex video games must teach the player how to play them — without losing sight of the need to provide a fun experience, or permitting the player to cheat — Koster identifies three game design features that are essential if the player is to experience learning. First, games must feature a "variable feedback system", providing responses appropriate to the players' achievements. Second, the "Mastery Problem" must

be addressed, by which Koster means that better or more experienced players should not be permitted to gain excessive advantage at the expense of inexpert players. Finally, "failure must have a cost" (2005, p.122): if a player is unable to complete a level or advance beyond a particular point in the game, their next attempt must be treated no differently from the last, failed attempt. To reward failure in a game by making the most challenging portions increasingly easy to master cheapens the experience and does little to prepare the player for the next challenge. By observing these rules, games are perhaps uniquely placed to induce the 'flow' state identified by Csikszentmihalyi (1991): an optimal state of mind that seems likely to produce conditions ideal for learning to take place, or at least, as Whitton (2010) suggests, a state that is "very similar to being highly engaged". As Whitton herself notes, flow theory as defined by Csikszentmihalyi might not adequately describe all such occurrences of this "optimal experience" or deep engagement, citing Draper's (1999) modification of flow theory. Draper suggests that flow comprises two distinct types: u-flow, which is characterised by an *unconsciously* managed flow of actions (such as those required to drive a car), and c-flow, where total *conscious* attention to the task is required. It seems likely that this more complex view of flow actually better describes what players experience: most fans of video games can probably recall (or not, as the case may be) the hours lost while 'in the zone', playing their favourite game. They can also, however, probably cite many examples of when they were not making any progress at all, pouring all of their conscious efforts into solving a particular puzzle, or defeating a particular foe.

The last of Koster's rules, that failure within a game should not be compensated for, is not always applied; or the rule is bent so subtly the player is unaware that the difficulty of the game is being adjusted to match their abilities. While it is generally accepted that games should increase in difficulty and complexity as the player progresses, many games offer players the opportunity to choose the level of difficulty they will face for the duration of the game at its outset (easy, normal, or hard; casual or expert). Some titles — Bethesda's *The Elder Scrolls V: Skyrim* being a recent example — actually allow the player to adjust the game's difficulty at almost any point in the proceedings. Competitive games such as Nintendo's *Super Mario Kart* have long made use of techniques commonly referred to as 'rubber banding'; these practices are designed to ensure that more experienced players, who naturally pull ahead of less capable participants in a race, are provided with fewer opportune in-game items (such as mushroom-based speed boosts or weaponised turtle shells). In this way, the elastic, notional 'rubber band' that represents the race order, with the front-runners pulling away from the stragglers at the back, snaps back into place and brings everyone back into contention by favouring struggling players. Going further still, dynamic difficulty adjustment algorithms (see Hunicke & Chapman, 2004) are used in games such a Valve's *Left4Dead* and

Capcom's *Resident Evil 5* to seamlessly adjust game content in response to the player's calculated capability.

These approaches to deal with different levels of aptitude offer an insight into the ways in which video games are designed to ensure that players remain engaged with the task at hand. Of course, most games should also offer a challenge — as should learning, in most cases — to be truly rewarding. And, as with approaches used in formal education, such as segregating classes based on student ability, finding an appropriate balance that meets all needs or expectations is a challenge: the Internet is rife with gamers bemoaning *Mario Kart's* rubber banding solution.

Steven Johnson's book *Everything Bad is Good for You: How Popular Culture is Making Us Smarter* (2006) features a typical – if anecdotal – example of learning from *SimCity*, wherein his seven year-old nephew quickly identifies the benefits of lowering industrial taxes when trying to encourage economic growth. But Johnson also identifies more subtle learning in video games that goes beyond the impressive but relatively straightforward understanding his nephew displayed after a few minutes of *SimCity*. He believes that the probing of a game as a system — discerning the rules of the game — is an intellectual endeavour, akin to the scientific method. Elsewhere, Johnson (2005) refers to the link between video games and a psychological principle known as the 'regime of competence' — identified by Gee (2004) — that describes how games are, as Gee suggests, "pleasantly frustrating" (2008, p.8). This relates directly to Koster's reflections on game difficulty, or balance: players should feel they are being challenged but should not be taxed significantly beyond their means.

The parallels between game design principles and those adopted in formal education are apparent. Learners' desire for feedback on their progress, and the benefits of providing feedback that is both realistic and useful, is another area in which the best games already excel. In classrooms or other formal learning scenarios where there is a range of student ability, the learning needs of students at all points on the scale should be addressed. The idea that failure should have a cost, however, is perhaps more controversial when transposed to a classroom — no reasonable educator would seek to punish less able students — but when considered in terms of assessment, this idea gets to the very heart of why we examine or otherwise assess students. Perhaps more important in terms of learning outcomes, failure to learn *should* carry some cost in an educational context. If a university student has failed to pass the first year of a three or four year degree programme, it is perfectly acceptable to expect them to re-sit (and pass) their exams, in order to demonstrate that they are capable of understanding the more challenging material that will inevitably follow.

As noted previously, the potential for learning from commercial video games has not gone unnoticed, as exemplified by Squire's work with *Civ*. At the forefront of the scholarly exploration of video games as learning tools is James Paul Gee, Professor of Literary Studies at Arizona State University, who makes connections between good game design and good educational design in his book, *Why video games are good for your soul: pleasure and learning* (2005). Gee (2004, p.15) examines how 'good' video games encourage players to learn the in-game mechanics and asks "why is a long, complex, and difficult video game motivating?" The answer, Gee believes, lies in the very fact that games are designed to teach us something and that this instructional experience taps into what he claims is a universal human desire to learn; certainly, we humans share a natural curiosity about the world with much of the animal kingdom. By studying the techniques developed by game designers to simultaneously engage and educate players on how to play the game or to discover more about the game world, some of the same approaches might be transposed to more conventional education. It's no coincidence that games are precision-tooled to promote player engagement: video game development is an often very costly commercial undertaking, and games must succeed at retail. This financial imperative leaves developers with two options: to continually simplify their games and make them so easy that no instruction is required to play, or to provide an effective but fun in-game learning experience that ensures the player is challenged but shrewdly so as to perpetuate their engagement.

Recent examples of commercial games being used to teach include Valve's Teach with Portals initiative[25], and the teacher-created *Minecraft* mod, MinecraftEdu[26]. Valve's initiative is based on their critically acclaimed *Portal 2*: a physics-based brain teaser, which sees the player solve a series of spatial puzzles using the innovative Handheld Portal Device, or 'portal gun', to navigate through increasingly complex rooms by creating holes in space, or portals. It must really be played, or at least observed in action, to be understood. The Teach with Portals website features lesson plans (again, aimed largely at school-age students, although the lessons are likely to appeal to older players) that guide the player through principles such as simple harmonic motion and Hooke's law, parabolas and terminal velocity. There are also opportunities to use the game to explore the concepts of character and setting, in terms of narrative and story-telling.

Aside from a few notable exceptions, such as the previously-discussed work of Hainey et al (2011), higher education (HE) is less well represented in the game-based learning (GBL) literature, with Whitton's *Learning with Digital Games: A Practical Guide to Engaging Students in Higher Education* (2010) standing alone as the only book dedicated to the topic (at time of writing in late 2012).

[25] http://www.teachwithportals.com/ (accessed August 2012)
[26] http://minecraftedu.com/ (accessed August 2012)

Whitton presents a series of cases studies, based on her PhD thesis (2007), that illustrate both the use of existing commercial off-the-shelf (COTS) games such as *World of Warcraft* and the development of bespoke educational titles, and is cautiously optimistic about the usefulness of video games in HE.

Elsewhere, Hobbs et al (2006) note that,

> "Current practice in Higher Education is moving away from didactic content delivery, the transfer of discrete, abstract, decontextualised concepts towards constructionist, student-centred models with increasing emphasis on the skills that support independent, self-motivated learning."

That game-based learning fits well with the move towards greater constructivism in HE teaching and learning is a notion echoed by Connolly et al (2004) who suggest that successful video games draw on a range of educational concepts including constructivism, situated learning and problem-based learning (PBL).

The literature does, however, reveal some conflicting evidence about the potential for video games to engage students. Egenfeldt-Nielsen (2007) conducted research in a similar vein to Squire's *Civ* work using another, even more history-focussed commercial strategy game, *Europa Universalis II*[27]. While acknowledging Squire's results, Egenfeldt-Nielsen documents a high degree of student resistance to the very idea of learning from a game. He goes on to detail some of the problems he, and others, have observed with using video games to teach. As Kirriemuir & McFarlane (2004) noted in their review of the literature of the time, one of the major issues associated with teaching with games is that both the teacher and the student must learn how to play the game, which can create a difficult-to-overcome initial barrier to further learning. Egenfeldt-Nielsen goes on to describe a "Bermuda Triangle of incompetence, conservatism and limited resources" (2007, p.149) that effectively stymied his efforts to teach with *Europa Universalis II*. In contrast, Squire — while acknowledging many challenges and offering solutions where possible — seems to have had a more positive experience, particularly in terms of student engagement.

Stealth learning (Prensky, 2001 p.24) is another theory associated with learning from commercial video games. The idea being, rather like members of Lave & Wenger's communities of practice or Gee's affinity spaces, that learning is taking place in video games without the player realising. Moreover, this learning is often intended by the game's designers. It would be interesting to

[27] http://www.europauniversalis3.com/ (accessed January 2012)

discover if the designers of games with, say, historical content (such as *Civ* and *Assassin's Creed*) harbour any desire for their players to learn about history from their games.

Learning outcomes

While much of the review thus far has concentrated on phenomena that have grown to become associated with game-based learning, it is important not to lose sight of what players might actually be learning. Looking at learning more generally, Gagne (1984) notes a "distinction between verbal information and intellectual skills (or declarative and procedural knowledge)". He identifies five varieties of learning outcome, each of which might be seen as relevant to learning from games: intellectual skills (procedural knowledge), verbal information (declarative knowledge), cognitive strategies (executive control processes), motor skills, and attitudes. Drawing on the work of Gagne and others, Garris et al (2002) agree that "most researchers conceptualize learning as a multidimensional construct" and present three broad categories of learning outcome: cognitive, skill-based and affective. Skill-based learning outcomes are here defined as "technical or motor skills", while affective outcomes are those that influence attitudes or beliefs. Cognitive outcomes are divided into three sub-categories: declarative (knowledge of facts and data), procedural (how to perform a task, by applying knowledge) and strategic (applying learned principles to different contexts or deriving new principles for general or novel situations – i.e. transferable skills).

Using games for assessment purposes is another current idea, linked to learning outcomes. Assessment has been described as "the future of serious games" (Michael & Chen, 2005, p.230), and games' almost unique suitability for testing our grasp of complex systems and ideas might yet represent significant educational potential.

Players as producers

Video games already provide many opportunities for players to produce content, not just consume it (as suggested by Gee's 'Insider Principle'). Level editing tools, such as those found in Media Molecule's *LittleBigPlanet* series (2008-present) allow anyone to build and share their own game scenarios, for example. A plethora of mods exists for everything from Valve's *Half-Life* (1998) to *Civ*, with game developers releasing software that facilitates the adaptation of their work by the player. On a basic level, any game or gaming platform that permits the creation of a character or avatar is providing players with the means to create, and to express themselves. Taking this notion further, there exists great potential for learning by creating or designing video games (Vos et al, 2011; Robertson & Howells, 2008) – perhaps the ultimate expression of Papert's constructionist sandcastles.

Video games also inspire players to develop their own content outside the games themselves. Recording and narrating or otherwise annotating game play sessions for delivery via YouTube are a common phenomenon, while player's contributions to gaming-related wikis may be considered near-academic in quality (Barr, 2013). Here, games are acting as the catalyst for players to practice and develop otherwise unrelated skills, but clearly transferable, such as video capture and editing, or writing wiki articles for an audience of fellow game fans. Of course, video games are not unique in inspiring extracurricular activity such as this, but the combination of their ubiquity (or, perhaps, their popularity), relative complexity and low barrier of entry (in terms of cost) make them ideal candidates for the focus of such endeavours.

Gamification

As a word, 'gamification' does not invite serious consideration of the concepts it encapsulates; however, better definitions of the term do provide an insight into what it might mean, and the potential usefulness of the idea.

Deterding et al (2011) suggest that "gamification is an informal umbrella term for the use of video game elements in non-gaming systems to improve user experience (UX) and user engagement", while Knapp (2012, p.10) defines gamification as "using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems" while it is "not the superficial addition of points, rewards, and badges to learning experiences." While such definitions are useful starting points, reducing the term to a short sentence does little to assuage the doubts of gamification's many nay-sayers, such as Ian Bogost (2011), who states:

"…gamification is marketing bullshit, invented by consultants as a means to capture the wild, coveted beast that is videogames and to domesticate it for use in the grey, hopeless wasteland of big business, where bullshit already reigns anyway."

The problem with the term 'gamification' or trite definitions thereof, is that can seem meaningless and empty, just as Bogost would have us believe. The use of rewards or 'badges' as they tend to be labelled by would-be gamifiers, is far from new: gold stars for good work have been a staple of many schools for decades. Other may argue that elements of gamification, such as leaderboards or points, are a distraction from the educational material, or that if your course requires some superficial bells and whistles such as those commonly associated with gamification, your course is fundamentally flawed to begin with. The greatest ire directed at gamification comes from the game community itself, including researchers such as Bogost again:

"Game developers and players have critiqued gamification on the grounds that it gets games wrong, mistaking incidental properties like points and levels for primary features like interactions with behavioral complexity."

However, in this assertion, Bogost is actually in agreement with the more thoughtful and experienced advocates of gamification. Knapp (2012, pp.28-50) agrees that it is in the interaction between various game-like elements that gamification of learning becomes effective. Among these components, Knapp lists "abstractions of concepts and reality", "goals", "rules", "conflict, competition, or cooperation", "feedback", "storytelling" (citing the Hero's Journey as an example), "aesthetics" and even "reward structures", provided they are not used in isolation. Knapp also points out that many, if not all, of these ideas have been used successfully in some form or another in classrooms before they were ever assembled under this umbrella. Other proponents of these techniques actively avoid the term "gamification". Lee Sheldon (2012), in his book *The Multiplayer Classroom: Designing Coursework as a Game* prefers his titular "multiplayer classroom" label, possibly aware of the baggage that "gamification" has quickly acquired.

Gamification is not limited to using game-like elements in education, of course. Fitness and personal training regimes, and associated products, have also utilised the 'game like' notions of high scores, performance tracking and competition to motivate those who have an interest in exercise. Nike+[28] is an online tool from the sports equipment manufacturer that allows users to track their physical activity. By means of dedicated hardware, such as the wrist-worn 'Fuelband' or smartphone app, one's running and other sporting endeavours may be measured and recorded. Further, the tool allows users to set friends challenges, obtain badges for successes and set persona goals. Perhaps unsurprisingly, there is also an Xbox 360 game[29] that works with the console's Kinect motion sensor to offer "real-time coaching"

Gee's 36 learning principles

James Paul Gee is a clear inspiration for this work. In perhaps his most influential work, 2003's *What Video Games Have to Teach Us About Learning and Literacy* – and the revised 2007 edition – Gee describes what he terms "semiotic domains" as a means of ascribing meaning to anything from images and sounds to objects and other humans. He defines a semiotic domain more precisely as "any set of practices that recruits one or more modalities (e.g. oral or written language, images, equations, symbols, sounds, gestures, graphs, artifacts, etc.) to communicate distinctive types of meanings" (2007, p.19). Among his examples, he includes Roman Catholic theology, cellular biology

[28] http://nikeplus.nike.com/plus/ (accessed 5 November 2013)
[29] http://www.nike.com/us/en_us/c/training/nike-plus-kinect-training (access 5 November 2013)

and first-person shooter video games. Or, if the reader is uncomfortable with the word "semiotic" Gee offers this even more straightforward interpretation: "an area or set of activities where people think, act, and value in certain ways" with one such area being video games. He argues that to be literate merely in terms of reading and writing is insufficient in the modern day: we must be literate in a variety of semiotic domains other than those associated with the printed word. So, Gee argues, one can be literate in one or more video game semiotic domains (a genre such as the aforementioned first-person shooter, or real-time strategy, or platformer is associated with its own domain) and this literacy is developed according to 36 learning principles, some or all of which modern video games have the potential to exploit. The most pertinent of these principles are discussed here, and grouped in a way that makes sense to me. The complete list is reproduced, in the order presented by Gee, in Appendix A.

1. **Active, Critical Learning Principle**
   All aspects of the learning environment (including the ways in which the semiotic domain is designed and presented) are set up to encourage active and critical, not passive, learning.

While Gee presents his principles in no particular order of importance, this first idea highlights one of the key aspects of Gee's thinking: that learning should be *active*. As discussed under 'Theories of learning' above, the utility of active learning is a widely-observed phenomenon: from the constructivism of Piaget (1956) to the experiential learning espoused by Kolb (1983), and Moy's (1999) assertion that graduate attribute-like skills can only be developed through active engagement. Video games are designed to engage the player in active learning – increasingly so in the era of the disappearing player manual – in such a way that they grasp the games' concepts and conventions by interacting with them. The critical aspect of this learning Gee grounds in the notion of "situated cognition": the player assigns meaning to objects, characters and events in terms of how they manifest within the context of the game.

3. **Semiotic Principle**
   Learning about and coming to appreciate interrelations within and across multiple sign systems (images, words, actions, symbols, artifacts, etc.) as a complex system is core to the learning experience.
4. **Semiotic Domains Principle**
   Learning involves mastering, at some level, semiotic domains, and being able to participate, at some level in the affinity group or groups connected to them.
5. **Metalevel Thinking About Semiotic Domains Principle**

> Learning involves active and critical thinking about the relationships of the semiotic domain being learned to other semiotic domains.

Gee's semiotic domains, and, in particular, the affinity groups with which they are associated have also have clear links with established learning theory such as Lave and Wenger's (1991) ideas about situated learning and communities of practice (see Gee, 2005) and Vygotsky's (1978) semiotic mediation. The emphasis Gee places on mastering such domains – even if they have been constructed around a video game – also suggests links with Bloom's (1971) learning for mastery. Video games certainly employ some version of mastery learning in their design. The player must generally master a level or area of the game before moving on to the next, but they may achieve mastery at their own pace: more able players can progress through the game more quickly, while less advanced players benefit from the constant feedback on their actions that game provides, so that they can ultimately master it. Indeed, mastery learning is closely related to a number of Gee's principles, for example:

> 13. **Ongoing Learning Principle**
> The distinction between learner and master is vague, since learners, thanks to the operation of the "regime of competence" principle listed next, must, at higher and higher levels, undo their routine mastery to adapt to new or changed conditions. There are cycles of new learning, automatization, undoing automatization, and new reorganized automation.
> 14. **"Regime of Competence" Principle**
> The learner gets ample opportunity to operate within, but at the outer edge of, his or her resources, so that at those points things are felt as challenging but not "undoable."

As noted above, there are echoes of Bruner's (1960) scaffolding, Bloom's (1968) mastery learning and Vygotsky's (1978) zone of proximal development (ZPD) in these principles. Gee's regime of competence, at the edges of which the learner/player should be found, is almost synonymous with Vygotsky's ZPD. While Vygotsky's intended learning environment comprised a more traditional classroom with a teacher helping students to navigate their ZPD, Gee is suggesting that video games can (and do) fulfil this role, at least in terms of learning about the game itself, and do so effectively. When the designers of a high-profile game ignore the regime of competence principle, they threaten to derail the whole endeavour: an excellent recent example is *Deus Ex: Human Revolution* (Square Enix, 2011). The game permitted – and often encouraged – the player to play entirely by stealthy means, avoiding direct conflict and honing a very particular set of skills that did not involve big guns. It would then suddenly throw the player into a ballistic gun fight with an end-of-level boss where stealth was meaningless and big guns were a fundamental requirement if the player was to progress.

So, rather than building on skills and competencies developed through previous interactions, the player's regime of competence was all but ignored, requiring them instead to master skills to which the majority of players had hitherto not been exposed. The reviews for the otherwise well-received *Deus Ex* uniformly – and justifiably – lambasted these incongruous battles[30].

> 6. **"Psychosocial Moratorium" Principle**
> Learners can take risks in a space where real-world consequences are lowered.
> 15. **Probing Principle**
> Learning is a cycle of probing the world (doing something); reflecting in and on this action and, on this basis, forming a hypothesis; reprobing the world to test this hypothesis; and then accepting or rethinking this hypothesis.
> 28. **Discovery Principle**
> Overt telling is kept to a well-thought-out minimum, allowing ample opportunity for the learner to experiment and make discoveries.

As relatively risk-free environments (due consideration must be given to games with violent or sexual content that might be unsuitable for children, or the often unmediated online interactions that many titles facilitate), video games allow players to experiment and develop not only an understanding of the game system but also the skills required to probe and hypothesise about the real world. Several writers have made this connection between games' apparent reliance on – and players' application of – the scientific method. Intuitively, it is easy to see how this idea makes sense, as one plays or observes another playing a video game wherein the player formulates strategies to progress, tries them out, and refines them as necessary. Steinkuehler and Duncan (2008) went on to produce empirical evidence of games' (specifically the researcher-favourite *World of Warcraft*) ability to foster what they term "scientific habits of mind". It is interesting to note that one of the University of Glasgow's stated graduate attributes is labelled "investigative", with its transferable dimension described as "able to investigate problems and provide effective solutions"[31].

> 7. **Committed Learning Principle**
> Learners participate in and extended engagement (lots of effort and practice) as an extension of the real-world identities in relation to a virtual identity to which they feel some commitment and a virtual world that they find compelling.
> 10. **Amplification of Input Principle**

[30] http://en.wikipedia.org/wiki/Deus_Ex:_Human_Revolution#Critical_reception As an aside, I have not played *Deus Ex* since I got stuck at the very first boss battle well over a year ago. It has since come to light that the game's boss battles were not created by the game's primary developers but were, in fact, outsourced to a different development team.
[31] http://www.gla.ac.uk/students/attributes/ (accessed 5th November 2013)

For a little input, learners get a lot of output.

11. **Achievement Principle**

For learners of all levels of skill there are intrinsic rewards from the beginning, customized to each learner's level, effort and growing mastery and signalling the learner's ongoing achievements.

12. **Practice Principle**

Learners get lots and lots of practice in a context where the practice is not boring (i.e. in a virtual world that is compelling to learners on their own terms and where the learners experience ongoing success). They spend lots of time on task.

Each of these principles, it seems, is to do with how and why video games command so much of players' attention and effort. Motivation has been discussed already, but more so than the remainder of Gee's 36 principles, this subset might require some qualification when applied directly to games. What these principles assume is that the learner enjoys being a player, too – if video games are not for them, then these principles aren't simply irrelevant, they can be counterproductive. Place someone, who has not played games before, in front of a title that requires quick reflexes and a mastery of somewhat abstract controls, something as 'universal' as *Super Mario Bros.* or a slower-paced but even more bewildering and impenetrable title, such *as The Elder Scrolls V: Skyrim* (Bethesda Softworks, 2011) and they will not feel that for a little input they are getting a lot of output. I don't believe Gee is asserting that all of these principles hold true for all games of all genres, and all people; rather, he is presenting a list of principles that *may* be observed in games and how players learn from them.

8. **Identity Principle**

Learning involves taking on and playing with identities in such a way that the learner has real choices (in developing the virtual identity) and ample opportunity to meditate on the relationship between new identities and old ones. There is a tripartite play of identities as learners relate, and reflect on, their multiple real-world identities, a virtual identity, and a projective identity.

9. **Self-Knowledge Principle**

The virtual world is constructed in such a way that learners learn not only about the domain but about themselves and their current and potential capacities.

These principles seem to suggest that the learner can discover something about themselves, by reflection or by projection on to their in-game identity. On their own, these principles, I believe, do have value but they perhaps become all the more powerful when considered in conjunction with

principles 30-32, each of which is concerned with the learner/player thinking "consciously and reflectively" about a number of cultural models, as presented in the game: models about the world, models about their own learning and models about the semiotic domain(s) in which they operate. Gee states that learner/players enjoy a certain freedom in thinking about these models, because they can do so using any combination of his "tripartite play of identities" without "denigration" of their own identity or social background.

All of Gee's principles deserve attention: this list is an attempt to draw out those that seem, at time of writing, most relevant to this work. Those principles that deal with literacy – reading video games as multimodal texts – are also important, as are those that deal with how games teach players to play them (e.g. the 'Bottom-Up Basic Skills Principle' and the 'Explicit Information On-Demand and Just-in-Time Principle') but this overview concludes with two, not entirely unrelated, principles.

> 35. **Affinity Group Principle**
> Learners constitute an "affinity group", that is, a group that is bonded primarily through shared endeavors, goals, and practices and not shared race, gender, nation, ethnicity, or culture.
> 36. **Insider Principle**
> The learner is an "insider", "teacher", and "producer" (not just a "consumer") able to customize the learning experience and domain/game from the beginning and throughout the experience.

The first of these principles seems to draw on established notions of communities of practice and social learning. It is perhaps an over-looked aspect of video games – certainly in the way they are perceived by those who do not habitually play them – but such groups do exist and now thrive as online forums, wikis and guilds, where they might once have been confined to the office or playground. In this way, the 'Affinity Group Principle' is linked to the 'Insider Principle' – the learner/player is also an active producer, not simply a passive consumer, creating content in and around the game, often in collaboration with other members of their affinity group. It might be argued that these two principles represent some of the most powerful potential in video games for learning, or at least a particular form of learning. Whereas some of the other – still important – principles can be applied only within a video game, these last two (and those related to them, such as the 'Semiotic Domains Principle') might offer a clue as to games' suitability as a framework for developing sought-after generic skills and attributes.

It is useful to consider how Gee's game-specific learning principles compare with others developed in more conventional educational settings. Chickering & Gamson (1987) offer seven principles of good practice in undergraduate education, of particular interest here due to the higher education focus:

1. Encourages student-faculty contact.
2. Encourages cooperation among students.
3. Encourages active learning.
4. Gives prompt feedback.
5. Emphasizes time on task.
6. Communicates high expectations.
7. Respects diverse talents and ways of learning

Stating that "while each practice can stand on its own, when all are present, their effects multiply", Chickering & Gamson suggest that these principles employ six powerful forces in education:

- Activity
- Diversity
- Interaction
- Cooperation
- Expectations
- Responsibility

There are clear parallels between some of these principles and those espoused by Gee. In particular, cooperation, active learning, feedback, time on task and diverse ways of learning are all key tenets of Gee's philosophy. Chickering & Gamson's principles share similarities with other work on good quality education. A 1995 report led by Colorado Governor Roy Romer, Chairman of the Education Commission of the States, identified the following attributes of quality undergraduate education, based on a review of the existing research (Romer, Ewell, Jones & Lenth, 1995):

Quality begins with an organizational culture that values:

- High expectations
- Respect for diverse talents and learning styles

- Emphasis on early years of study

A quality curriculum requires:

- Coherence in learning
- Synthesizing experiences
- Ongoing practice of learned skills
- Integrating education and experience

Quality instruction builds in:

- Active learning
- Assessment and prompt feedback
- Collaboration
- Adequate time on task
- Out-of-class contact with faculty

Again, there is considerable overlap with Gee's principles but one difference, in particular, stands out. While both lists of HE-focussed principles touch on the importance of "high expectations", an equivalent principle is missing from Gee's list. The other common difference is, understandably, related to contact with teaching staff, who are necessarily absent from video games. These differences seem linked primarily, then, to the environments in which the learning takes place (in a game versus in a college or university). It does not necessarily follow that games are characterised by low expectations (although, learning outcomes may be unexpected). What is more striking is just how much commonality exists between Gee's game-based learning principles and those that are held in high esteem in higher education.

Games' negative impact on learning

There are also reports of games being detrimental to learning. Allert (2004) conducted a study of students taking an introductory computer science course, to examine which learning styles and other factors contributed to academic success. Those factors which had a positive impact on student attainment were related to the importance of project work and, unsurprisingly, the amount learned. Factors for which there was only a small positive correlation comprised mainly of prior technical knowledge (programming languages, etc.). The factors with by far the strongest negative correlations, however, were "Days spent in tutoring center" and "Prior experience computer gaming". This is, perhaps, an especially surprising outcome given the computer-based nature of the course: Allert speculates that one reason for such a correlation might be that students with an

interest in video games mistakenly assumed that an introductory computer science would relate directly to the creation of such software. Allert also speculates that games may simply have taken up too much of these students' time and attention, away from their studies. These data are important because they show empirically that video games can have a detrimental effect on learning outcomes. While further research would be required to determine the exact cause of this correlation – and the cause may be quite innocuous, such as the students' misconceptions about course content – there exists very little quantitative data that supports a positive correlation between games and learning.

It should be noted that some of the research reveals problems that have arisen when attempts have been made to introduce commercial video games to educational settings. As researchers including Kirriemuir & McFarlane (2004) and Egenfeldt-Nielsen (2005) have found when games are used in a formal classroom, these difficulties can range from simple hardware or software faults to teachers' unfamiliarity with the games being used, and even to a lack of interest from potential learners: video games are immensely popular, yes, but not everyone enjoys playing them. One of the more subtle themes to be found in the existing literature – which is not typically brought to the fore – is that video games are probably not the panacea for learning that some advocates would suggest.

Preliminary Work

Introduction

With scholars including Gee (2003), Egenfeldt-Nielsen (2005) and Squire (2011) extolling the pedagogic potential of video games for some time, and several generations having grown up with gaming as a commonplace facet of their existence, there exists an opportunity to explore how video games have indirectly taught, or otherwise influenced, those who have played them all their lives. Much effort has been expended on the production of educational video games, but the aforementioned researchers are particularly relevant to the work described here, as they have examined the use of commercial video games – those designed, developed and marketed for entertainment purposes – in educational contexts. James Paul Gee has been particularly influential in making the case for the learning potential in games, with an emphasis on literacy and on systemic thinking, ever since he observed his six-year-old son playing a non-educational game called *Pajama Sam* (Gee, 2008). Similarly, Kurt Squire's work (2004) with the historical strategy game, *Civilization III*, has demonstrated that games which have enjoyed immense commercial success also have a role to play in learning.

As part of the preliminary stages of a larger piece of work on incidental learning in commercial video games, a number of focus group sessions, divided into all-male and all-female cohorts, were conducted. The purpose of these sessions was to probe the two groups' potentially disparate attitudes to learning from video games. The discussion was also designed to investigate the influence games might have had on players' vocational or academic choices, and any other attendant effects gaming might have had on the their lives. Here, the female perspectives are examined in greater detail, with findings from the male focus group used to highlight differences in attitude that may relate to gender.

Participants

In line with the aims of the wider project to which this work relates, focus group participants were all in the adult age range, and drawn from a mixture of staff and students at the University of Glasgow. Volunteers with an interest in video gaming were sought from the outset: while the opinions of non-gamers may provide an interesting counter-balance to the opinions expressed here, the work is currently focussed on the 'gaming generation', or those who have grown up playing video games.

The average age of the female cohort was slightly lower than that of the male group, being drawn mostly from undergraduate courses in the School of Humanities, rather than the blend of staff and postgraduate students the male group comprised. While age was not recorded or considered explicitly, the difference in mean age between the two groups was revealed in the participants'

descriptions of their gaming habits, past and present, and may help explain at least one of the key differences in attitudes between the two groups (online interaction – discussed below).

While many of the male participants cut their gaming teeth on the hardware of the 1980s, including the Atari ST, ZX Spectrum and Nintendo Entertainment System (NES), the younger female participants' first gaming experiences were mostly on the original PlayStation, released in Europe in 1995, with some earlier memories of playing on a Super Nintendo Entertainment System (SNES, released 1992 in Europe) or Sega Mega Drive. One female participant did, however, recall owning a ZX Spectrum.

Many of the female participants' earlier gaming tended to take place on hardware owned by other people (brothers, cousins, or friends). This might simply be a result of the slightly younger age range in the female group – by the mid-1990s, there was a greater probability that an older relative or friend already owned a games console of some kind, facilitating that first encounter – but it seems likely that gender is a factor here, with girls, at least as recently as the end of the last century, less likely to own their own video game console or computer. That social norms might discourage girls from enjoying video games is not a particularly remarkable idea, and it is borne out by later comments that suggest the interest in gaming displayed by these female respondents was quite unique amongst their peers. However, if video games really have been exerting an influence on current generations' learning, or other facets of their lives, then access to games may be an important factor. One could speculate, for example, that the boys growing up in the late 1980s and early 1990s – for whom hours spending playing *SimCity* on a computer was considered a legitimate pastime – were more likely to become the city planners, architects and waste disposal experts of today. If girls have been discouraged from games that might ultimately inspire a career in an already male-dominated profession, then lack of access to video games due to social pressure is potentially reinforcing this dominance.

In terms of the games played by our female participants, the cited titles included those that might be considered 'girl friendly' in the most general, stereotypical terms – *Pokémon*, for example – but were dominated by games that might more typically be described as 'hard core': *World of Warcraft*, *Skyrim, Dragon Age, Super Mario Galaxy* (not the more casual *New Super Mario Bros.* titles), *Age of Empires, Tomb Raider* and *Assassin's Creed*, to name a few of the more popular examples. Subverting the stereotype of the female gamer entirely, the pet dog and cat simulator series, *Petz*, which is actively marketed towards young girls, was singled out as "the worst game… it was so bad!" Just when the series became so unappealing to this cohort of young girls was disputed, however:

"When babies came out it hit a new low."

"It was bad from the beginning!"

The block-based puzzle game, *Tetris*, is considered by some to be a long-standing example of a game with cross-gender appeal. This assumption, too, was challenged:

"I think I started with the very first Game Boy – my brother had it. He had Tetris, I hated it. It was just… I didn't have the patience."

"What I hate about Tetris is that it's never-ending. When I complete a task I like to just finish it but [Tetris] just feels like it's forever and ever…"

"It was worth it, though, because once you got past a certain point, you got the rocket. I loved Tetris."

"I talk to Tetris-loving people all the time and we just don't get along!"

So, while the main focus of the work here is on what the gaming generation has learned from video games, the opportunity to frame the discussion in terms of gender was also explored.

Influence on academic or vocational choices

All of the student participants in the male group were drawn from the MSc in Information Technology course and, coincidentally, all of the staff involved had at one point or another completed the same degree. Given the obvious bias in this cohort, it is perhaps unsurprising that there was some sort of link between a childhood interest in computer games, and studying computing at university. At least one of the participants was confident that his earliest programming experiences, which comprised entering 'pokes' or game cheat codes into his Spectrum computer in the 1980s, had fuelled his interest in computing and ultimately influenced his career (and, by extension, his current computing-related PhD). However, there are clearly many questions to be addressed if it is to be demonstrated that playing video games from a young age can have a direct influence on later career direction (or lack thereof). One would be bound to ask if the interest in computers cited here existed in this person anyway, and the desire to enter small, tedious snippets of code via a keyboard was merely an expression of this interest. Also, what of the influence of peers: family and friends with an interest, or even an existing career, in computers? At least one male participant acknowledged that his father's job, teaching computing science at secondary school level, may have had a bearing on his enduring fascination with technology. The prospect of gainful employment is another powerful motivator alluded to by some of the male participants, all of whom

have lived through an era when a career in IT has, for some years at least, been presented as a lucrative option.

The female group described more tangible video game influences on their academic choices. One participant quickly cited *Tomb Raider*, which she used to demonstrate the fun to be had with video games to her non-gaming friends, with some success. She recalls that she and her friends "got really into the story and found out all the information that was based on history… sort of researching into it. We found out that it was mostly conspiracy theories." When asked if any of what she learned from this research had stayed with her, she offered the following response:

"It's sort of remained in the back of my head, so when people start talking about it… yes. But I could give other games as [better] examples – that is a bit of a niche, I mean, it was talking about nephilims, mythical creatures and about secret orders that were controlling the world. So it's not exactly the kind of conversation with just anyone but it's still amusing, it's still interesting."

While *Tomb Raider* struck a chord with many, this description of being inspired to research some of the historical and mythical content presented in the game led to another student asserting that she had experienced a similar desire to discover more after playing the historical action-adventure, *Assassin's Creed*. This assertion was met with voluminous noises of approval, or, at least, recognition. The student elaborated:

"I do History and I was studying at the same time [as playing *Assassin's Creed*] and I was like 'oh, wow, maybe I should go to the library and read some of these books'."

In common with the general consensus among the male group, the single female participant with experience of studying a computer-related subject at university (Software Engineering) also drew parallels between her enjoyment of the subject and that which she derived from gaming:

"I got into the subject because I love problem solving. Also because of learning languages which I'm pretty good at, but mostly it's that you have a problem and you need to reach the solution step-by-step. So it felt like in a game where you have to figure out the system you're working in."

Whilst the student went on to qualify this statement, making clear the fact that games were only one of her interests and therefore only a partial (but "obvious") influence on her academic choices, she acknowledges that in playing a game, she's thinking about it as a system. This type of systemic thinking is a common theme in the work of Gee, Squire and others looking at the learning potential of video games. In his book, *Everything Bad is Good for You: How Popular Culture is Making Us Smarter,* author Steven Johnson (2005) suggests that developing an understanding of a game as a

system – discerning the rules of how it should be played, testing the limits of the simulated world – is an intellectual endeavour, akin to the scientific method. Certainly, the process of trial and error involved in developing the correct strategy for progressing through a challenging game is not unlike the procedure of formulating, testing and refining a series of hypotheses, in research terms. "Figuring out the system you're working in" is also one way of describing the learning that takes place when children play (Moyles, 1989). In the case of children playing, the system being figured out is the world we live in, and the toys or other objects with which the child interacts – be they inanimate or animate (as any family pet would attest) – the scientific tools or subjects. Video games excel at providing an environment in which to experiment as there is zero cost associated with in-game experimentation: no animals are harmed if a player explores alternative strategies for pet care in *Nintendogs + Cats* and World War Three is unlikely to be instigated by a game of *Counter-Strike* taking an unpleasant turn. Games such as *Portal* and its much-lauded sequel take the notion of games as experimental environments almost literally: the games are largely presented as a series of test chambers set within a crumbling commercial research facility and players encouraged to escape each room by experimenting with their physics-bending 'portal gun'.

Transfer of knowledge

The transfer of knowledge, or learning facts from a teacher, book or game, is perhaps the most straightforwardly measured aspect of game-based learning, but it is also arguably the most trivial. Nonetheless, participants in these focus groups professed to have gained knowledge from playing games and were keen to describe what they had learned, even if the true value of this learning was unclear. One male participant claimed to have benefitted from games that attempt to recreate real-world locations, even if the recreations were historical rather than contemporary. Aside from the somewhat dubious assertion that playing a game such as *Assassin's Creed II*, which features recreations of medieval Italian towns including Monteriggioni, led to "better orientation" when on holiday in the region, the male participants felt that this "sprinkling of authenticity" made such games feel more "worthwhile". It was widely felt that there was some benefit to playing games that open up the possibility of learning about a place or time to which we haven't been. However, the group voiced concerns about whether or not all that was presented as authentic in such games was based on fact, revealing a healthy scepticism akin to that displayed by Squire's *Civilization III* players (Squire, 2011).

One male participant claimed to have been able to apply knowledge gained from modern shooting games about guns and other equipment in his military career, while another believed he had learned Microsoft DOS commands ("by absorption") as a result of using a PC for much of his early gaming. More generally, the male group expressed an interest in learning and exploiting the in-game

systems. However, it was conceded that little of what they learned about specific game mechanics was applicable outside of gaming, or even in other games; more generic gaming conventions were considered to be transferrable, however, with the phrase "shoot the red barrel" summing up this broad understanding of the visual language than spans many titles. All participants were familiar with the convention which states that a red barrel in a room full of more mundanely-hued containers will explode when shot: a property that, if properly exploited, can provide the player with a tactical advantage during a fire-fight.

Our female respondents were less forthcoming with examples of knowledge learned from video games, or, at least, knowledge that was useful beyond the confines of the game world. One participant, an army cadet, has played *Conflict: Desert Storm* with her cadet colleagues – although she was quick to point out that this was not her own choice – while many of the other cadets enjoy playing *Call of Duty*. She noted that the use of call names (or call signs) and the portrayal of radio security and other communications aspects of the military appeared reasonably realistic, but there was little evidence that this realism had resulted in any significant learning. Another female participant described an educational game, designed to teach the player the German language, wherein each word you learn is represented by flower that you may plant in your virtual greenhouse. The participant stated that she was "into it because I had to look after my flowers, not because I had to learn German" but conceded that she did still remember the German vocabulary associated with her horticultural collection. While not strictly a game, another student cited Code Academy (http://www.codecademy.com/) as an example of a novel learning experience – designed to teach programming fundamentals using the JavaScript language – that certainly exhibits some game-like characteristics (abundant feedback, badges for achievement, an overall 'score'). The 'gamification' of learning – and other aspects of life, including one's career and health – is too large a topic to consider here, but later work will probably have to address this recent trend (or fad, as the case may be).

Touching on the possibility of learning historical or geographical facts from one the many first-person shooter (FPS) games featuring an historical setting, such as World War II (*Call of Duty, Day of Defeat*), one respondent commented:

"I don't really like history that much. I like *Day of Defeat* because I like reading war novels and things like that but from a more sociological point of view, how people dealt with it all."

Striking a chord with rest of the group, this respondent also stated that she prefers the historical *Day of Defeat* to its Valve stable mate, *Counter-Strike*, because she feels more "disconnected" from the historical version. The modern *Counter-Strike*, she feels, is "too real".

Moving beyond the FPS genre, other popular games with historical content included *Red Dead Redemption*, set in the Old West: "That was really good. Because I hadn't really thought about [that historical setting]… I don't know how real it was." The female participants also enjoyed being able to find out more about the buildings and places depicted in *Assassin's Creed*, which provides the player with the option of reading about any of the famous locations when they visit them in the game world, should they choose to do so.

The historical strategy game *Napoleon: Total War* was also singled out, as its tutorial level "taught you history as well as how to play the game. That was really interesting because it taught me a lot about Napoleon, which I had no idea about." Staying with the historical strategy genre, *Age of Empires* also proved popular. One participant, who currently studies Classics, claimed to be able to relate her studies back to the social structures depicted in the game, with memorable details ranging from how citizens interacted with slaves to how people were dressed. Being asked to choose to play as a particular nation inspired another player to research each of the nationalities presented in the game. An intuition that the exploitation of horses could be a key component of her nation's winning strategy led to the player's decision to choose the Mongols, based on what she had learned about their use of cavalry.

Other examples of knowledge gained from historical strategy games cited by the female participants included learning about how Roman cities were run in *Caesar III*, and using another game to supplement existing knowledge of Imperial China.

The female group had a great deal more to say about the knowledge required to complete or advance in a game, and the use of resources such as gaming wikis and online FAQs to obtain this knowledge. While the male group mentioned the use of such resources briefly (see also 'Skills, behaviours & attitudes' below) and highlighted the importance of understanding in-game conventions, the topic appeared to divide the female group and inspired further discussion.

The first female participant to describe the use of online sources of game information stated that she would "Google or consult a Nintendo magazine forum if stuck" but such courses of action were "like admitting defeat". The same respondent also indicated that she would be most inclined to consult online discussion forums, or even purchase a printed 'walkthrough' guide. The mention of walkthroughs led to the following comments from another participant:

"I use walkthroughs all the time. Games like *Zelda*, don't want to miss. Also things like *Harvest Moon*: if you play it just by yourself you will miss so much e.g. stuff happens only on certain days of the year that you might miss if you're not prepared. You read beforehand."

This defence of the use of walkthroughs was quickly rejected by another of the more vocal participants:

"Walkthroughs kind of bore me, especially the books you can get… you're not actively playing the game, I always felt. You're just sort of following this book and that's not the fun part."

When asked if she might use a walkthrough or similar guide to ensure she uncovered all of a game's secrets on a second play-through (re-playing a game to explore anything that might have been missed the first time is apparently a common course of action, at least within the female cohort), this participant stated that she never did so. Instead, she played through a game once "for the fun of it" and typically on the easiest difficulty setting: "I play how I want and not care about, you know, completing it on the hardest difficulty." While she did not care if she found all of the hidden items or secrets, she enjoyed simply exploring the game world at her own pace and "learning all the lore". In this regard, she enjoys reading the "reference material" that relates to games such as *Pokémon*, *Minecraft*, but the intention is not to improve her game but, rather, to immerse herself in the game world.

The same participant's experiences with the MMORPG (Massively Multiplayer Online Role Playing Game) *World of Warcraft* (*WoW*) were different, however. In *WoW*, "you had to read strategy guides before going on a raid, go off and watch a video, know how to defeat the boss, or you were out." The difference here, perhaps, is that the player is not playing alone: as the member of a 'guild', a player has certain responsibilities to their fellow members and must know what they are doing when they set off on a difficult quest together:

"The more hard-core the guild, the more strategy, the more extra reading you have to do… [You] need to know how much damage a boss will do, what moves to do when… if you don't know you're wasting peoples' time."

While one other participant strongly disagreed with the notion that a game should require or, at least encourage, background reading or preparatory work, the general consensus among the female participants was that walkthroughs and other reference material were "important for doing it properly". One respondent summarised the feelings of the larger group with her comment that she gets "stressed" thinking she'd missed one "the wee secrets."

Skills, behaviours & attitudes

The bold claim made by one male respondent that playing the PlayStation racing game *Midnight Run* had made him a "better driver", and improved his driving skills, was actually supported by a number of participants. Karting games (such as *Super Mario Kart*) were reported to have provided an understanding of driving concepts such as racing lines, apex entry and exit, and braking techniques, for example. Male participants again suggested their early experiences of computer games had imparted a number of technical abilities, ranging from the aforementioned command-line skills to an understanding of computer hardware, with experience gained from upgrading PC components to play the latest games. The female group was less convinced of the influence that mastering early computer game systems could have on their skill set. When asked if she thought her Spectrum experience had enhanced her computing skills (as implied by the male group), the one female Spectrum owner simply replied "I doubt it". She elaborated:

"It wasn't like I was spending all day typing in BASIC code then 'run' then some lame thing happened. When you're ten you don't really understand the language you're typing in, you're just copying it from a mag."

So, there is certainly a difference in perspective here. However, the female participant went on to provide some further detail about her Spectrum days that opened up an unanticipated topic for discussion:

"I got rid of my Spectrum quickly... I was quite young and I was playing it too much and was dislocating my fingers and I was like 'that's gross' and took a bit of hiatus from gaming."

The revelation that this player had dislocated her fingers playing video games was immediately seized upon by the other female participants: 50% of the group had injured or in some way hurt themselves whilst playing. Complaints included sore thumbs ("'Nintendo thumb' is quite common"), perennially bad wrists, damaged shoulders and facial injuries caused by flying Wii Remotes. On playing one of the many bowling games available for Wii: "I bowl properly anyway… I've done more damage playing video games than I have doing real bowling." There have been reports of Wii-related 'injuries' in the press since the console's release in 2006, but that 50% of this female cohort have harmed themselves as a result of their hobby – with many of the examples pre-dating the motion-controlled Wii – seems quite remarkable. As one observer suggested, one might expect blisters or even the occasional sprained ankle to be incurred as a result of a more active pursuit such as hill walking, but even in the case of a hobby such as this – which intuitively carries a higher risk of physical injury than video gaming – such a high rate of injury seems unlikely.

Opinions on video game controversy (such as game content that some media outlet deems inappropriate) and the more subtle normative aspects of games (such as the way in which gender stereotypes are portrayed) differed between the groups in at least one respect: the female group had a great deal more of them. When asked how they felt about games reinforcing gender stereotypes (as exemplified by the hulking male hero, and the helpless damsel in distress), the male participants acknowledged there was an issue, but suggested that games – or game designers – could not be blamed for regurgitating these representations of gender. One male participant went so far as to lament the typical "no neck" image of the burly, thoughtless male protagonist that pervades games, film and television.

Participants' attitudes to online gaming, and the social interaction this type of connectivity permits, also differed between the male and female groups. While there was absolutely no appetite for playing online with or against relative strangers in the male group (most of whom preferred to "pit their skills" against a known person situated physically in the same room), members of the female group were much more likely to have engaged in online interaction, often with players from very different backgrounds, living in countries across the world. The potential for transcultural or international interaction that might exist in online gaming networks was completely unfulfilled among the male group. For the female participants playing *World of Warcraft*, international contact was mostly limited to Europe (Americans, for example, play on different servers to minimise lag times and to maximise the number of available players in proximate time zones). However, at least one *Warcraft* player encountered some particularly polite Scandinavians, who felt their conversational English was improved by chatting with UK-based players. One participant gave the example of two Finns speaking in their native tongue as she joined their party: they apologised immediately and switched to speaking English so as not to exclude the English-speaker.

"The last *World of Warcraft* guild I was in was one of the best ones and I'm pretty sure that everyone was not British."

Many female participants highlighted the social skills that playing an online game such as *World of Warcraft* can develop, particularly as a result of being encouraged to work as part of a team. On the social facets of online gaming, one female participant had this to say:

"I played *Warcraft* for ages and it had a really social aspect… I didn't really have a life because I was studying Computing Science at the time so I'd come home and play *Warcraft* and I'd sit in raids with a text book in front of me, trying to study, and people in Vent [Ventrilo chat software] would be like

'[participant name], are you ready?' and I'd be like, yeah, I'm ready, but not looking at the screen because I'm reading. So it was… that was pretty much my social life for about three years."

So, did gaming have a negative impact on her studies?

"Not really, wasn't a course I enjoyed anyway. Don't think I would have put much time into it anyway. Dunno, still managed to pass."

Elaborating on the motivations that drove her to play *World of Warcraft* consistently over the course of her three year degree, the same participant continues:

"I enjoyed playing in a team, as I was always bad at sports but I was a really heavy raider in *World of Warcraft*. It's twenty-five people and you had to be really organised and I really enjoyed that. Really liked being part of that. Taught a lot about how to act in a team environment and sometimes how to lead a team."

This last point, that playing *WoW* had had provided valuable experience of operating as part of – and leading – a team was met with widespread agreement from the group. The group was then asked if they might refer to these experiences in a job interview, in response to the ubiquitous teamwork-related question. Another participant replied:

"I actually would be tempted to, yeah, but they would look at you like you're a weirdo because there's such a stigma with video games, like 'they don't teach you anything, it's just a bit of fun'. That's actually not true."

And, continuing her comparison to sports:

"It's just, I think, that people don't realise you actually work in a team when you're playing a video game. Well, obviously it depends on which one, but they always think of it as a solitary activity and it's not really. Whereas sports you can actually, physically see that there are lots of people working together."

Another participant – studying Software Engineering – agreed:

"I think it's the same with problem solving. In a job interview you wouldn't mention it [problem solving in games] but if they're asking for times when you've solved a problem… you only use your real life, but how often does that happen? In a game you're spending hours and hours… much better practice than in real life occurrences."

While there was widespread agreement that experience of teamwork gained from playing games such as *Word of Warcraft* was beneficial, not all of the female participants enjoyed co-operative play. One participant described the teamwork in *Portal 2* – which features both a significant single player campaign and a multiplayer component that is entirely co-operative – as "you do this and I'll do that", stating that she enjoyed the solitary feeling of the single player game. Another participant made the following observation about co-operative (co-op) play:

"I think you have to play the co-op [in *Portal 2*] with someone you truly work well with. It feels like it's just the epitome of team work."

Commenting that playing a co-operative game such as *Portal* 2 without a microphone (and your partner collaborating remotely over the Internet) was "just shouting at the TV." Perhaps tellingly, the following two observations were made in quick succession:

"If they're an idiot it's not going to work."

"I played with my boyfriend and somehow it didn't work."

Also, not everyone was of the opinion that the social interactions practised in video games could be reproduced in the real, physical world. When asked if video games help with their actual social interaction, on respondent exclaimed "No!" and suggested that her online interactions were not comparable to those outside of gaming, as she was more confident while "hiding behind her avatar".

Turning to some of the negative attention directed towards video games, and starting with the *Call of Duty* 'airport massacre' controversy (as reported in the mainstream media: http://www.dailymail.co.uk/news/article-1226588/Call-Duty-Political-storm-brutal-video-game-allows-killing-civilians-airport-massacre.html), the female participants had this to say:

"Blown out of proportion. I dunno, maybe it's just me but it's just pixels on a screen."

"Some people seem to miss that quite a lot. You get lots of game controversies and you just think 'it's a game'!'"

One participant articulated what she believed was the key difference between this controversial scene (where the player assumes the role of a CIA 'deep cover' agent and thus is apparently allied with the terrorists carrying out the airport massacre) and a game such as *Grand Theft Auto*. In the *Call of Duty* level, the protagonist dies and does not feature elsewhere in the game, whereas in *GTA* the player assumes the role of a criminal for the duration of the game, the object of which is to amass wealth and power by murdering and maiming citizens as required. There was a general

distaste for games such as *GTA* amongst the female group, but the prevailing attitude was that other individuals creating and playing such games – which simulate violence in a real world setting – were welcome to do so: the games simply weren't for them. In a fantasy setting, such as that employed by *World of Warcraft*, the portrayal of racism and sectarian violence was more widely accepted, even welcomed: "I think it's an interesting comment on our world when video games try to emulate things like racism."

However, the female participants' experience of online gaming and interacting with other players via voice or text chat, for example, has not been uniformly positive. One participant recalls the messages she received from other players during her first experience of playing online role-playing game *Runescape*: "[I was] bombarded with n00b, n00b, n00b" (where 'n00b', or 'newbie' is a common insult directed at inexperienced players). As unwelcoming as this practise sounds, it was generally accepted by the group. Another female participant responded: "That would have been me typing it at you."

Video games and gender

While the previous "n00b" comment might have been received well enough here, the introduction of gender to the discussion quickly complicated the issue of online interaction in games.

A selection of participant comments reveals the depth of the perceived gender divide in the gaming community:

"On forums, it's better if you don't have your gender listed. I've found that if I go on somewhere listed as a girl, I get 'ooh [or, possibly "eww", implying distaste rather than simple incredulity] girl gamer'."

"If you're playing *Call of Duty* with a headset on and they happen to hear you're a girl, it's just a torrent of abuse".

And in *World of Warcraft*, which has proved to be popular with this cohort of female players:

"So many of the guilds I've joined, first time on Vent: 'Oh my God, you're a girl!'. Usually because they don't expect you to be, because you're a warrior or tank [the player that holds the main boss]."

"Apparently no girls play Tauren [a bovine race of large, muscular shamans]. I'm like: I'm not going to be a Blood Elf warrior! They'll break with one hit! Plus, Taurens are kind of cute. Now I go Tauren, even more people think I'm a guy".

Another participant recalled turning on her microphone in an online FPS, revealing that she was a girl, and being told to "get back in the kitchen", while a *Runescape* player explained that if she was playing as a male character she'd be left alone but, if she was known to be female, she'd be showered with gifts from other (mostly male) players. One participant described her first and only experience of playing *Call of Duty* online with a headset: the game effectively ground to halt as the awe-struck American players with whom she was playing came to realise she was a girl. In the end, she played the game with her headset switched off.

So, is there a gender issue or gender divide in video games?

"In some games, yes."

"In all games!"

The group was asked how they felt about the portrayal of women in games, a question that was met with many irritated sighs: "You mean the dopey damsel in distress?" While Princess Peach form *Super Mario Bros.* was singled out as a particularly poor female characterisation, Princess Zelda from Nintendo's *The Legend of Zelda* series was identified as being "quite a good female character". Lara Croft from the *Tomb Raider* games was also, perhaps inevitably, cited as a strong female presence in a mainstream video game franchise. However, it was felt that the character had not been treated with appropriate care over the series' various iterations:

"Tomb Raider. It's amazing."

"Until recently!"

Describing one of the more recent entries in the *Tomb Raider* series, one participant offered this analysis:

"I think actually the last *Tomb Raider* sort of said something. They were trying to make it some new, gritty… and they made into just this… weak and just incredibly… exactly the opposite of why I used to love *Tomb Raider*: because she was so strong and interesting."

On watching a video of the latest *Tomb raider* gameplay [the Lara Croft character is said to be the victim of an attempted rape in the opening scenes of the game], she continued:

"This is not *Tomb Raider*! I feel like I should protect her or something! I don't feel like I'm a tomb raider, kicking ass… It's just so sad. I just felt so sad. I could understand why the guys didn't get it but I was like 'stop hitting her!' She was like, so weak, I couldn't watch the video anymore."

In terms of equality, *World of Warcraft* was cited as one game that provided balanced – if idealised – portrayals of both sexes. The official *Formula One* games, however, allowed one player to enter her (female) name, only to be addressed with male pronouns throughout her racing career.

Sexuality in games, too, was an issue for some of the female participants. *The Sims* was referred to as "pretty amazing for a video game" as it allows for homosexual households. The recent outcry (primarily in the United States) over the option to pursue a homosexual relationship in *Mass Effect 3* was branded "ridiculous" by the group, with one player pointing out that "the critics didn't know how the game works, that it took hours to romance them [your prospective partner], as it were." The *Dragon Age* games, developed by *Mass Effect* creators, BioWare, were praised, with one player recalling that "you could have three-ways or even four-ways."

Conclusions

While the exact nature of the educational nourishment offered by video games is not fully revealed here, it seems safe to conclude that – amongst those who play them – there is a sense that games are not a waste of time. That these short sessions have revealed such a wide range of interesting topics related to learning from video games, from games' motivational power to their ability to reinforce gender stereotypes, suggests that future work is justified: the problem may be in defining an appropriate research question, or set of questions.

In terms of learning, specifically, a number of learning strategies are hinted at in these discussions, which may warrant further investigation. These include:

- Trial and error ("zero cost" experimentation)
- Consulting external sources, e.g. wikis, walkthroughs
- Peer discussion
- Learning from one game and applying in another (i.e. identifying and applying conventions)

In the context of higher education, where this work will be focussed, a number of possible lines of enquiry are suggested. Not least, it has been noted that some of the attendant benefits of gaming described here (e.g. experience of working as part of a team) align closely with our own institution's stated 'graduate attributes'. There may be scope for examining the role the video games may have in developing or even assessing these desired attributes in our students. Some of the perceived value in gaming that is alluded to here – specifically that games encourage and develop imaginative problem solving – might, in fact, be unique to gaming. If this is the case, then video games may play a role in graduate development that higher education currently cannot fulfil.

Games' position in our attention cycle is almost certainly unique. While some focus group respondents cited a desire to 'switch off' by playing video games, there is little doubt that games are more interactive – if not necessarily intellectually stimulating – than television, for example, which has facilitated 'switching off' in western culture for over 50 years. The question is, can the intellectual stimulation that games may provide be measured, and, in the case of this research, retrospectively?

The research that these focus groups are designed to help inform is still being carried out, but the sessions detailed here have revealed (or confirmed) a number of problems and variables that the proposed research methodology must address or control for. Certainly, selection bias is evident in the male cohort in particular but this is not considered problematic for an exercise such as this, where the object is to probe the construction of some proposed research questions. Subsequent research, however, must take into account the academic background of future participants: that all of the male participants were drawn from, or had previously taken, the same MSc IT course would significantly skew any data collected, for example. Of greater concern with research of this nature, which seeks to illuminate and document the effects of video games on individuals many years after they first played them, is recollection bias. A mixture of nostalgia and hazy memory affects how research participants report their early gaming habits, and complicates the process of drawing a line from the games played to academic choices made perhaps decades later. It takes an exceptionally configured mind to be able to recall and pinpoint the exact moment in the past a particular fact was first learned, a concept or system understood, or a belief of attitude revised.

3. Research Methodology

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